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United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Wilkin County, Minnesota

Soil Survey of Wilkin County, Minnesota

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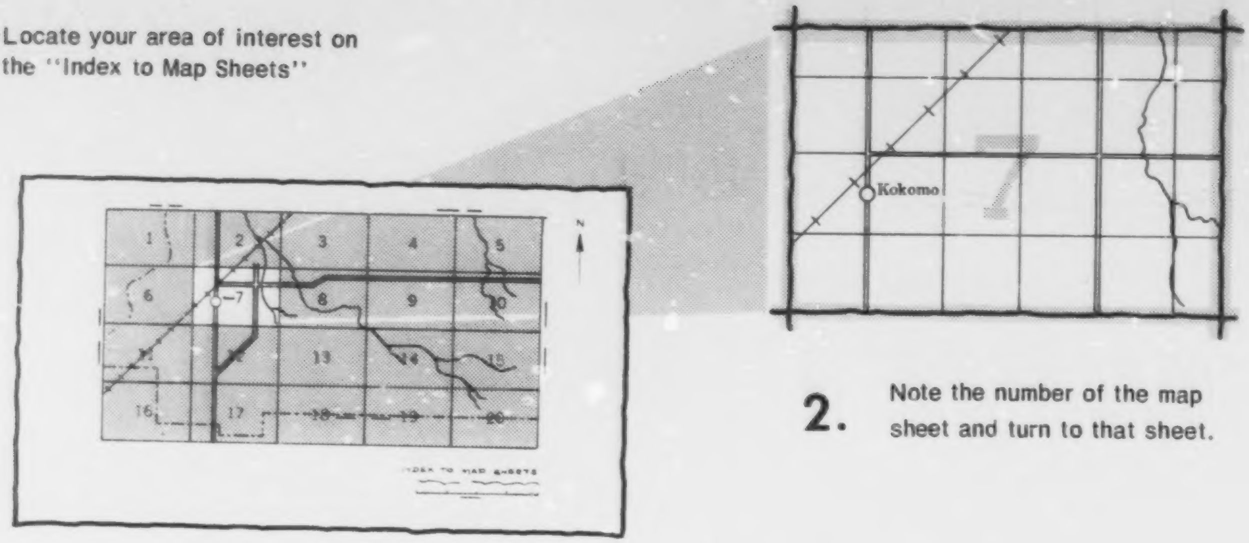
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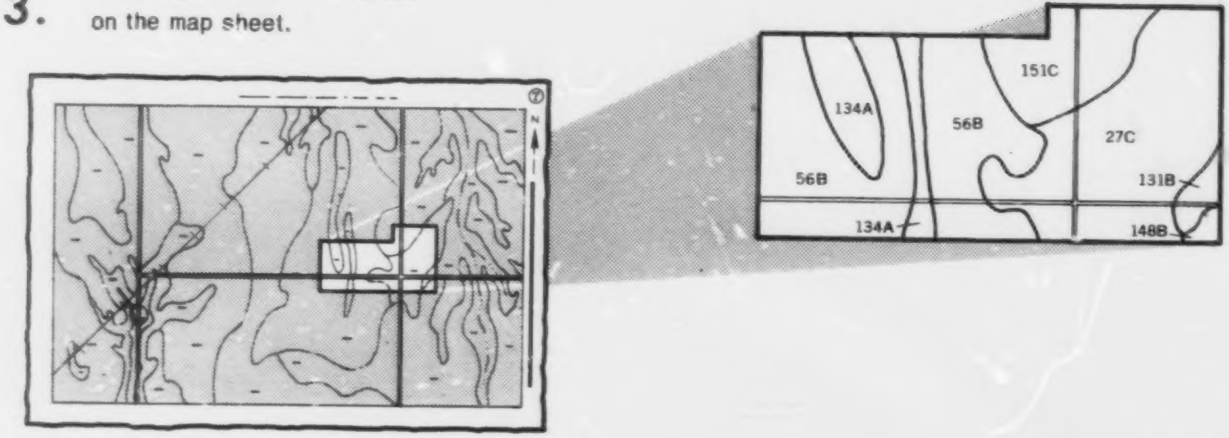
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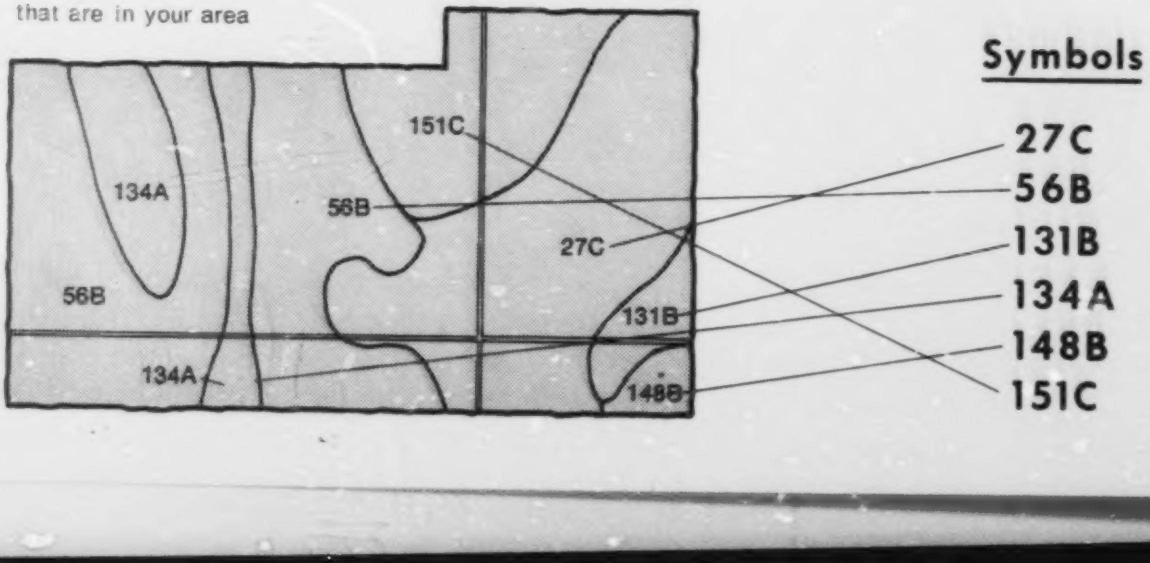
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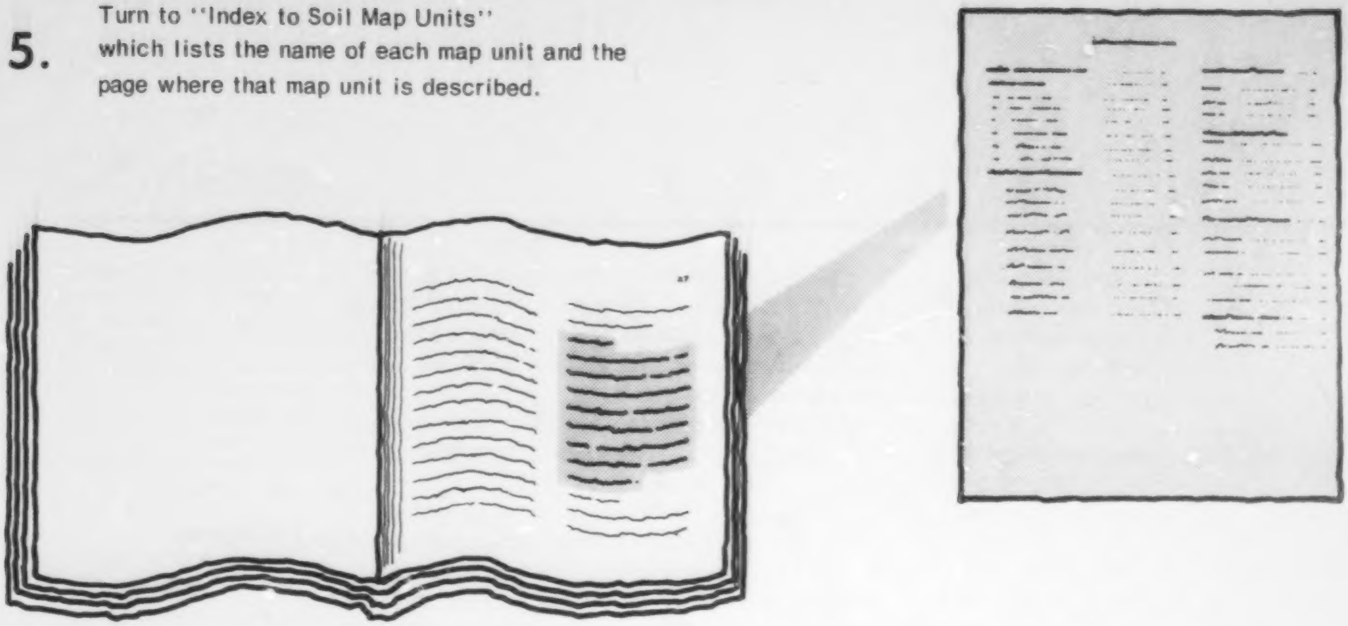
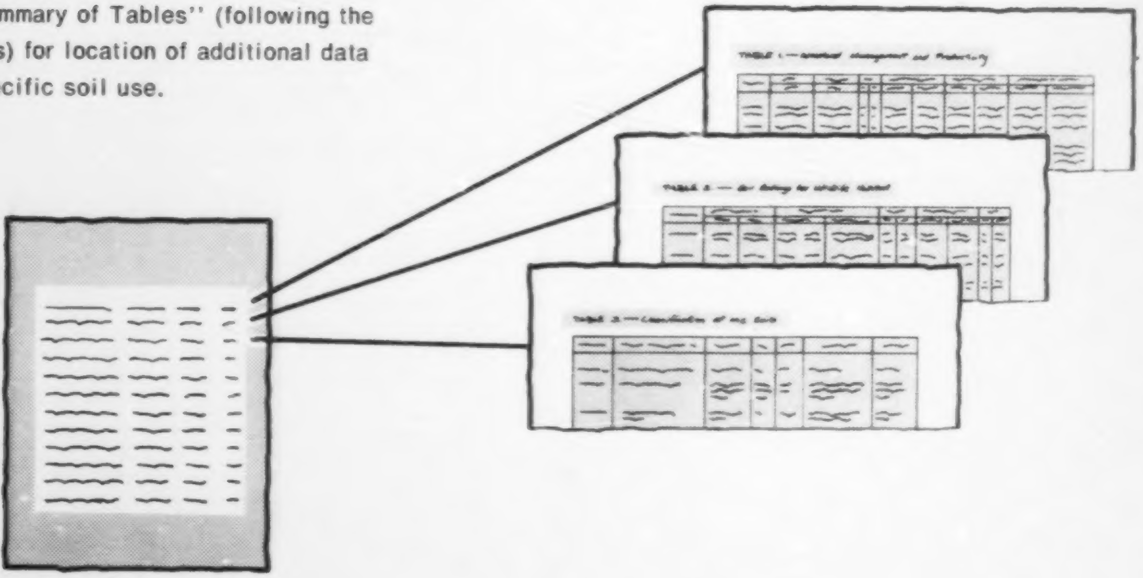
THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service and the Minnesota Agricultural Experiment Station. It is part of the technical assistance furnished to the Wilkin County Soil and Water Conservation District. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Wilkin County. Additional assistance was provided by the Minnesota Soil and Water Conservation Board and the Minnesota Agricultural Extension Service.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Harvesting wheat on a Fargo silty clay and a Doran clay loam. Wheat is the most common small grain crop grown in Wilkin County.

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Foreword

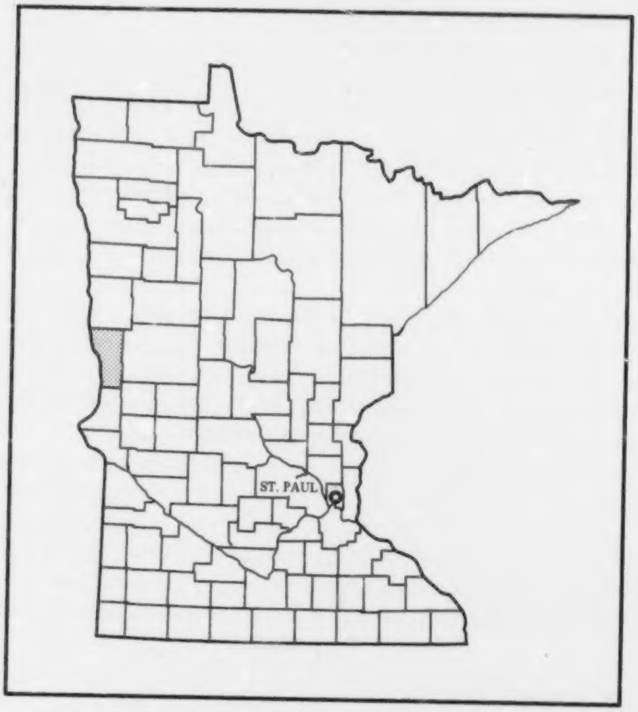
This soil survey contains information that can be used in land-planning programs in Wilkin County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Gary R. Nordstrom
State Conservationist
Soil Conservation Service



Location of Wilkin County in Minnesota.

Soil Survey of
Wilkin County, Minnesota

By Malvern N. Jacobson, Soil Conservation Service

Fieldwork by Malvern N. Jacobson and Donald DeMartelaere,
Soil Conservation Service, and Charles N. Gordon, Peter Hartman,
Scott Hooper, Grant Johnson, and Dave Tufvesson,
Minnesota Agricultural Experiment Station

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Minnesota Agricultural Experiment Station

General Nature of the County

Wilkin County is in west-central Minnesota. It borders North Dakota. It has a total area of 481,087 acres, or about 752 square miles. The total water area, excluding rivers and streams, is about 200 acres. Breckenridge is the county seat. It has a population of 3,909. Other towns include Doran, Foxhome, Kent, Rothsay, and Wolverton.

The county was first settled in 1856 *(9)*. Plans were drawn for a city of 673 blocks at Breckenridge. In 1862, the town was destroyed during an Indian raid. Only a sawmill was left standing. Breckenridge was not resettled until 1871, when the railroad reached the county.

This soil survey updates the reconnaissance survey of the Red River Valley in Minnesota published in 1939 *(5)*. It provides additional information and larger maps, which show the soils in greater detail.

Physiography, Relief, and Drainage

The highest points in Wilkin County are on the low hills directly north of Rothsay, where the elevation is about 1,250 feet above sea level. The lowest point, about 890 feet above sea level, is in northwest corner of section 6, in Wolverton Township.

The elevation generally drops 45.3 feet in the 38 miles from the southern boundary to the northern one and 62.9 feet in the 14 miles from the eastern boundary to the southern one. These elevation figures do not include the higher uplands in the northeastern part of the county, where a complex landscape is characterized by short, uneven slopes and many depressions and draws. Slopes in these uplands are nearly level to moderately steep. They are as much as 18 percent.

Most of the county is in the basin of glacial Lake Agassiz. This basin generally is nearly level, but the ridges of sandy and gravelly material along the shorelines and the slopes adjacent to stream channels are steeper.

The soils on uplands in the northeastern part of the county generally formed in loamy or silty glacial till. In some areas they formed in colluvium, alluvium, or outwash. The soils in the basin of glacial Lake Agassiz formed in lacustrine sediments or in lake-washed glacial till. The clayey soils are mainly in the northwestern part of the county, and the sandy and gravelly soils are on the shorelines of glacial Lake Agassiz.

The major drainage systems in the county drain into the Bois de Sioux River or the Red River of the North (fig. 1). The main tributary to the Bois de Sioux River is the Rabbit River. The Otter Tail River joins the Bois de Sioux River at Breckenridge, where it becomes the Red River of the North.

Surface water in the northern part of the county drains north and west into Whiskey Creek, Wolverton Creek, Deerhorn Creek, and the South Branch of the Buffalo River. Numerous draws and coulees also drain the county. An extensive system of ditches has been

Figure 1.—The Red River of the North, near McCauleyville. This is the largest river in the county. It flows northward into Canada.

constructed to aid in draining excess water from farmland.

Many of the soils along ditches and in the northeast corner of sections are subject to rare flooding because of the slow movement of water across a landscape characterized by a drop in elevation of only about 1 foot per mile. The water tends to build up along roads and ditchbanks before flowing onto the next section. The flooding occurs only during periods of excessive runoff following rapid snowmelt or unusually heavy rainstorms.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Campbell in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 10 degrees F, and the average daily minimum temperature is -1 degrees. The lowest temperature on record, which occurred at Campbell on January 16, 1977, is -41 degrees. In summer the average temperature is 68 degrees, and the average daily maximum temperature is 81 degrees. The highest recorded temperature, which occurred at Campbell on August 20, 1976, is 105 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 21.86 inches. Of this, nearly 17 inches, or about 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 3.2 inches at Campbell on August 3, 1956. Thunderstorms occur on about 33 days each year.

The average seasonal snowfall is 34 inches. The greatest snow depth at any one time during the period of record was 36 inches. On the average, 35 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 14 miles per hour, in spring.

Farming

Wheat, oats, barley, potatoes, and hay cut from native prairie grasses were the principal crops grown by the first farmers in Wilkin County. These farmers found most of the prairie soils difficult to break but very productive once broken and cultivated.

Farming is currently the most important enterprise in the county. In 1981, the county had a total of 660 farms, which averaged 700 acres in size. Wheat was the most important cash crop. The average yield of wheat was 36.6 bushels per acre. Other important crops were barley, oats, sunflowers, corn, soybeans, and sugar beets *(8)*. Some areas are used for pasture and hay.

The number of livestock in Wilkin County has decreased in recent years, but the number of livestock per farm has generally increased. Only a small number of farms raise livestock. Most of these farms are in the northeastern part of the county. A few farms in the western part raise and feed hogs. Some livestock are raised on farms near streams and rivers. In 1981, the county had about 10,000 hogs; 8,000 beef cattle; 2,000 dairy cattle; and 300 sheep.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, alkalinity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinements in series concepts, different slope groupings, and the application of the latest soil classification system.

Soil Descriptions

1. Fargo-Northcote Association

Nearly level and gently sloping, poorly drained soils formed in clayey lacustrine sediments; on lake plains

The major soils in this association are typically on broad flats and in shallow swales. A few areas are on gentle slopes parallel to streams. Local relief is typically slight. Slopes range from 0 to 6 percent.

This association makes up about 7 percent of the county. It is about 55 percent Fargo soils, 10 percent Northcote soils, and 35 percent soils of minor extent.

Fargo soils are nearly level and gently sloping. Typically, the surface layer is black silty clay about 11 inches thick. The subsoil is clay about 31 inches thick. The upper part is black, the next part is dark olive gray, and the lower part is olive gray and calcareous. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous silty clay.

Northcote soils are nearly level. Typically, the surface layer is black clay about 9 inches thick. The subsoil is very dark gray and dark olive gray clay about 11 inches thick. The underlying material to a depth of about 60 inches is dark gray and olive, mottled, calcareous clay.

Of minor extent in this association are the somewhat poorly drained Bearden, Cashel, and Perella soils, the poorly drained Enloe and Viking soils, and the moderately well drained Wahpeton soils. Bearden soils are in the higher landscape positions. They are calcareous at or near the surface. In some areas they are mapped in complex with the Fargo soils. Cashel soils are generally in low areas adjacent to streams and are occasionally flooded. Enloe soils are in swales and depressions. They are mapped in complex with the Fargo soils. Viking soils are mainly in landscape positions similar to those of the Fargo soils. They have coarse fragments and are calcareous. Wahpeton and Perella soils are typically in the slightly higher areas adjacent to streams.

Nearly all the acreage of this association is cultivated. A small acreage, mostly adjacent to the major streams, is wooded. Wheat, barley, sugar beets, soybeans, corn, and sunflowers are the chief crops. The soils are well suited to most of the crops commonly grown in the county. Wetness is the major limitation in the areas used as cropland. A drainage system is needed. Controlling soil blowing and maintaining fertility are additional management concerns.

2. Hamerly-Doran Association

Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy glacial till and in lacustrine sediments; on uplands, lake plains, and till plains

The major soils in this association are on broad flats and on low ridges. Local relief generally is slight. Slopes typically range from 0 to 2 percent.

This association makes up about 51 percent of the county. It is about 45 percent Hamerly soils, 30 percent Doran soils, and 25 percent soils of minor extent.

Hamerly soils are somewhat poorly drained and moderately well drained. Typically, the surface layer is black, calcareous clay loam about 9 inches thick. The subsoil is very strongly calcareous clay loam about 16 inches thick. It is grayish brown in the upper part and light olive brown in the lower part. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous clay loam that has pockets of gypsum crystals.

Doran soils are somewhat poorly drained. Typically, the surface layer is black clay loam about 9 inches thick. The subsoil is very dark grayish brown and dark grayish brown clay about 13 inches thick. The underlying material to a depth of about 60 inches is olive gray and olive, mottled, strongly calcareous silty clay loam.

Of minor extent in this association are the poorly drained Clearwater, Colvin, Lindaas, and Vallers soils and the somewhat poorly drained and moderately well drained Aazdahl, Donaldson, and Kittson soils. Clearwater, Colvin, Lindaas, and Vallers soils are in draws, in depressions, and on the slightly lower flats. Aazdahl, Donaldson, and Kittson soils are on low ridges and broad flats.

Nearly all the acreage of this association is cultivated. Small grain, corn, sunflowers, sugar beets, and soybeans are the main crops. The soils are well suited to crop production. Soil blowing is the principal hazard in the areas used as cropland. In some areas a drainage system is needed to remove excess surface water and to lower the water table. Maintaining or improving fertility also is a management concern. In places stones hinder the use of farm machinery.

3. Wheatville-Bearden-Glyndon Association

Nearly level and gently sloping, somewhat poorly drained and moderately well drained soils formed in silty or loamy lacustrine sediments; on lake plains

The Wheatville and Bearden soils in this association are on nearly level, broad flats, on low ridges, and in gently sloping areas that typically are parallel to streams. The nearly level Glyndon soils are on low ridges and broad flats. Local relief is slight. Slopes range from 0 to 6 percent.

This association makes up about 10 percent of the county. It is about 40 percent Wheatville soils, 20 percent Bearden soils, 15 percent Glyndon soils, and 25 percent soils of minor extent.

Wheatville soils are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is black silt loam about 10 inches thick. The subsoil is dark gray, calcareous very fine sandy loam about 7 inches thick. The upper part of the underlying material is light yellowish brown, mottled, calcareous loamy very fine sand. The lower part to a depth of about 60 inches is olive, mottled, calcareous silty clay.

Bearden soils are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is black, calcareous silty clay loam about 9 inches thick. The subsurface layer is very dark gray, calcareous silty clay loam about 6 inches thick. The subsoil is grayish brown, calcareous silt loam about 18 inches thick. The underlying material to a depth of about 60 inches is light olive brown and grayish brown, mottled, calcareous silt loam.

Glyndon soils are nearly level and are somewhat poorly drained and moderately well drained. Typically, the surface layer is black, calcareous very fine sandy loam about 9 inches thick. The subsurface layer is very dark gray, calcareous very fine sandy loam about 4 inches thick. The subsoil is dark gray, calcareous sandy clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive brown and light yellowish brown, mottled, calcareous very fine sandy loam.

Of minor extent in this association are the moderately well drained Aazdahl soils, the poorly drained Augsburg and Colvin soils, the poorly drained and very poorly drained Borup soils, and the somewhat poorly drained Elmville soils. Aazdahl and Elmville soils are typically on low ridges and broad flats. Augsburg, Borup, and Colvin soils are in draws, in depressions, and on low flats.

Nearly all of this association is cropland. Small grain, corn, potatoes, sugar beets, and sunflowers are the main crops. The soils are well suited to crop production. Soil blowing is the principal management concern. Water erosion is a hazard in the gently sloping areas. A drainage system is needed in some areas to remove excess surface water and lower the water table. Improving or maintaining fertility is an additional management concern. Excessive amounts of calcium carbonate limit the availability of plant nutrients.

4. Elmville-Donaldson Association

Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy or sandy lacustrine sediments or in glacial till; on lake plains

The major soils in this association are on broad flats and in slightly convex areas near streams. Local relief is slight. Slopes range from 0 to 2 percent.

This association makes up about 15 percent of the county. It is about 41 percent Elmville soils, 19 percent Donaldson soils, and 40 percent soils of minor extent.

Elmville soils are somewhat poorly drained. Typically, the surface layer is black, calcareous fine sandy loam about 9 inches thick. The subsurface layer is very dark gray, calcareous loamy very fine sand about 6 inches thick. The subsoil is grayish brown, calcareous loamy very fine sand about 6 inches thick. The upper part of the underlying material is light olive brown and yellowish brown, mottled, calcareous loamy very fine sand and very fine sand. The lower part to a depth of about 60 inches is olive gray, mottled, calcareous silty clay.

Donaldson soils are somewhat poorly drained and moderately well drained. Typically, the surface layer is black very fine sandy loam about 9 inches thick. The subsoil is dark grayish brown, mottled very fine sandy loam about 10 inches thick. The upper part of the underlying material is light yellowish brown, mottled loamy very fine sand. The lower part to a depth of about 60 inches is dark gray, mottled, calcareous silty clay.

Of minor extent in this association are the moderately well drained Aazdahl, Foldahl, and Hilaire soils, the poorly drained Augsburg and Espelie soils, the somewhat poorly drained and moderately well drained Glyndon and Grimstad soils, and the poorly drained and very poorly drained Rockwell soils. Aazdahl, Foldahl, Glyndon, Grimstad, and Hilaire soils typically are in slightly convex areas on broad flats. Augsburg, Espelie, and Rockwell soils are in swales and on broad, low flats.

Nearly all of the acreage in this association is used as cropland. Small grain, sugar beets, sunflowers, corn, and potatoes are the chief crops. The soils generally are well suited to crop production. The principal hazard is soil blowing on the Elmville soils. Water erosion is a hazard in the more sloping areas. In some areas a drainage system is needed to remove excess surface water and lower the water table. Improving or maintaining fertility is an additional management concern. Excessive amounts of calcium carbonate limit the availability of plant nutrients in the Elmville soils.

5. Wyndmere-Ulen-Flaming Association

Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy or sandy sediments; on lake plains

The major soils in this association are mainly on broad flats, in slightly convex areas, and on some low ridges. Slopes range from 0 to 2 percent.

This association makes up about 6 percent of the county. It is about 39 percent Wyndmere soils, 28 percent Ulen soils, 21 percent Flaming soils, and 12 percent soils of minor extent.

Wyndmere soils are somewhat poorly drained. Typically, the surface layer is very dark gray fine sandy loam about 11 inches thick. The subsoil is dark gray and grayish brown, calcareous fine sandy loam about 16 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown and light olive brown, mottled, strongly calcareous fine sandy loam.

Ulen soils are somewhat poorly drained and moderately well drained. Typically, the surface layer is very dark brown fine sandy loam about 11 inches thick. The subsurface layer is very dark grayish brown, calcareous loamy fine sand about 5 inches thick. The subsoil is dark grayish brown, mottled, calcareous loamy fine sand about 7 inches thick. The underlying material to a depth of about 60 inches is pale brown and light brownish gray, mottled fine sand.

Flaming soils are moderately well drained. Typically, the surface layer is black loamy fine sand about 9 inches thick. The subsoil is about 13 inches of very dark grayish brown loamy fine sand and dark brown and dark grayish brown fine sand. The underlying material to a depth of about 60 inches is pale brown and grayish brown, mottled fine sand.

Of minor extent in this association are the poorly drained and very poorly drained Arveson and Rockwell soils, the poorly drained Borup and Fossum soils, the somewhat poorly drained Elmville soils, and the moderately well drained Foldahl soils. Arveson, Borup, Fossum, and Rockwell soils are in swales and on broad, low flats. Elmville and Foldahl soils are generally in slightly convex areas or on low ridges.

Most of the acreage in this association is cropland. A few areas of the Flaming soils are used for hay and pasture or are idle. Small grain, corn, sunflowers, potatoes, and soybeans are the chief crops. The suitability for crop production ranges from good to poor. The principal hazard is soil blowing. The Flaming and Ulen soils are droughty, especially when rainfall is below normal. In some areas a drainage system is needed to remove excess surface water and lower the water table. Improving or maintaining fertility is an additional management concern. Excessive amounts of calcium carbonate limit the availability of plant nutrients in the Wyndmere and Ulen soils.

6. Lohnes-Sioux Association

Nearly level and gently sloping, moderately well drained, well drained, and excessively drained soils formed in sandy or loamy deposits; on lake plains and outwash plains

The Lohnes soils in this association are in nearly level and gently sloping areas. The Sioux soils are on gently sloping side slopes and the crest of ridges. Slopes range from 0 to 6 percent.

This association makes up about 3 percent of the county. It is about 69 percent Lohnes soils, 8 percent Sioux soils, and 23 percent soils of minor extent.

Lohnes soils are moderately well drained and well drained. Typically, the surface layer is black sandy loam about 12 inches thick. The subsoil is about 9 inches of dark grayish brown loamy sand and dark yellowish brown sand. The underlying material to a depth of about 60 inches is grayish brown, light brownish gray, and light yellowish brown gravelly loamy sand.

Sioux soils are excessively drained. Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown gravelly loamy coarse sand about 3 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown gravelly coarse sand.

Of minor extent in this association are the poorly drained and very poorly drained Arveson soils, the somewhat poorly drained and moderately well drained Divide and Ulen soils, and the poorly drained Rockwell, Syrene, and Vallers soils. Arveson, Rockwell, Syrene, and Vallers soils are in swales and depressions and on broad, low flats. They have a very high water table. Divide and Ulen soils are typically in nearly level and slightly convex areas.

About 50 percent of this association is cultivated. The rest is permanent hayland or pasture or is idle land.

Small grain, sunflowers, corn, and legumes are the main crops. The soils are poorly suited or generally unsuited to crop production. Droughtiness is the principal limitation in the areas used as cropland. Controlling soil blowing and maintaining fertility are additional management concerns. The Sioux soils are a good source of gravel.

7. Urness-Haug Association

Level, very poorly drained soils formed in silty lacustrine sediments or organic deposits; on lake plains and ground moraines

The Urness soils in this association are in lake basins. The Haug soils commonly are in depressions, in swales, and on low flats on lake plains and ground moraines. Slopes are 0 to 1 percent.

This association makes up about 2 percent of the county. It is about 45 percent Urness soils, 45 percent Haug soils, and 10 percent soils of minor extent.

Typically, the upper 48 inches of the Urness soils is black and very dark gray, mottled mucky silt loam. The underlying material to a depth of about 60 inches is dark gray, calcareous clay loam.

Typically, the surface layer of the Haug soils is black, calcareous muck about 14 inches thick. The subsurface layer is very dark gray, slightly calcareous loam about 6 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, calcareous silt loam.

Of minor extent in this association are the poorly drained and very poorly drained Arveson soils, the poorly drained Rockwell, Vallers, and Winger soils, and the very poorly drained Seelyeville and Quam soils. Arveson and Seelyeville soils are in landscape positions similar to those of the Haug and Urness soils. Quam soils are in depressions. Rockwell, Vallers, and Winger soils are in the slightly higher landscape positions. Also of minor extent are some areas of Haplaquolls and Histosolls, ponded.

Many areas are idle and support sedges, cattails, lowland brush, and patches of trees. If drained, the soils are fairly well suited to crop production. Flooding and ponding are the principal hazards. Soil blowing is a problem if unprotected fields are cultivated. Low fertility is an additional management concern.

8. Barnes-Rothsay Association

Nearly level to hilly, well drained soils formed in loamy or silty glacial till or lacustrine deposits; on till plains, lake plains, and moraines

The landscape of this association is one of short, complex slopes, deep depressions, well defined drainageways, and low valleys. The major soils are dominantly on gentle slopes or on hills. Slopes range from 1 to 18 percent.

This association makes up about 6 percent of the county. It is about 45 percent Barnes soils, 30 percent Rothsay soils, and 25 percent soils of minor extent.

Typically, the surface layer of the Barnes soils is black loam about 10 inches thick. The subsoil is very dark grayish brown loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive brown, calcareous loam and clay loam.

Typically, the surface layer of the Rothsay soils is black silt loam about 11 inches thick. The subsoil is dark brown silt loam about 5 inches thick. The next layer is pale brown, strongly calcareous silt loam about 10 inches thick. The underlying material to a depth of about 60 inches is yellowish brown, calcareous silt loam and light yellowish brown very fine sandy loam.

Of minor extent in this association are the moderately well drained Darnen and Hantho soils and the very poorly drained Parnell and Quam soils. Darnen soils formed in colluvium at the base of slopes. Hantho soils are in nearly level areas. Parnell and Quam soils are in depressions.

Most of the acreage in this association is used for small grain, corn, sunflowers, soybeans, hay, or pasture. The suitability for crops and pasture ranges from good to poor. Water erosion and soil blowing are the principal hazards. Improving or maintaining fertility and tilth is an additional management concern.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Fargo silty clay, 0 to 2 percent slopes, is a phase of the Fargo series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Rothsay-Zell silt loams, 2 to 6 percent slopes, eroded, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Haplaquolls and Histosols, ponded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinements in series concepts, different slope groupings, and the application of the latest soil classification system.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

26—Aazdahl clay loam. This nearly level and gently undulating, moderately well drained soil is on ground moraines in the basin of glacial Lake Agassiz. It is typically on slightly convex slopes. Individual areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is black clay loam about 12 inches thick. The subsoil is dark grayish brown clay loam about 6 inches thick. The underlying material to a depth of about 60 inches is calcareous silty clay loam. It is light olive brown in the upper part and grayish brown and mottled in the lower part. In some areas the soil is more silty. In a few areas the dark surface layer is more than 16 inches thick. In some areas on the lake plain, the soil is subject to rare flooding.

Included with this soil in mapping are small areas of Barnes, Donaldson, Doran, Hamerly, and Kittson soils.

Barnes soils are well drained and typically are in the higher landscape positions. Donaldson, Hamerly, and Kittson soils are somewhat poorly drained and moderately well drained. They are on the lower parts of the landscape. Doran soils are somewhat poorly drained and are on flats on the lower parts of the landscape. Included soils make up about 15 percent of the unit.

Permeability is moderately slow in the Aazdahl soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 3 to 6 feet.

Most areas are cropped. This soil is well suited to cropland. Unless the surface is protected, soil blowing is a hazard. It can be controlled by crop residue management, conservation tillage, and cover crops. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is I.

33B—Barnes loam, 1 to 6 percent slopes. This nearly level and gently undulating, well drained soil is on till plains. It is typically on side slopes and the crest of knolls. Individual areas are irregular in shape and range from 4 to 100 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsoil also is loam about 10 inches thick. The upper part is very dark grayish brown, and the lower part is dark grayish brown. The underlying material to a depth of about 60 inches is light olive brown, calcareous loam and clay loam. In places layers of sand and gravel are in the underlying material. In some areas the soil has a higher content of very fine sand and silt. In other areas moderate erosion has removed part of the topsoil.

Included with this soil in mapping are small areas of Aazdahl, Darnen, Kittson, and Langhei soils. Aazdahl and Darnen soils are moderately well drained and are in swales and on the lower side slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in the slightly lower swales. Langhei soils are calcareous throughout. They are at the crest of knobs and on slope breaks. Also included are some small areas of poorly drained soils. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Barnes soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

Most areas are cropped. This soil is well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIe.

33B2—Barnes loam, 2 to 6 percent slopes, eroded. This gently undulating, well drained soil is on till plains. It is typically on side slopes and the crest of knolls. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is brown loam about 6 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown and light olive brown, calcareous loam. In some places layers of sand and gravel are in the underlying material. In other places the soil has a higher content of very fine sand and silt. In some areas it is not eroded. In other areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Aazdahl, Darnen, Kittson, and Langhei soils. Aazdahl and Darnen soils are moderately well drained and are in swales and on the lower side slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in the lower swales. Langhei soils are well drained and are at the crest of knobs and on slope breaks. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Barnes soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium or rapid.

Most areas are cropped. This soil is well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIe.

34—Parnell silt loam. This level, very poorly drained soil is in shallow swales and small depressions on ground moraines. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black silt loam about 20 inches thick. The subsurface layer is dark grayish brown loam about 4 inches thick. The subsoil to a depth of about 60 inches is very dark grayish brown and grayish brown, mottled silty clay. In some areas the subsurface layer is discontinuous.

Included with this soil in mapping are small areas of the poorly drained Roliss and Vallers soils. Roliss soils are on the higher flats, and Vallers soils are on the rims of depressions. Included soils make up about 15 percent of the unit.

Permeability is slow in the Parnell soil. Available water capacity is high. Organic matter content also is high. Surface runoff is very slow or ponded. The seasonal high water table is 2 feet above to 2 feet below the surface.

Most areas are cropped. This soil is fairly well suited to cropland and well suited to pasture. The wetness is the principal limitation. Ponding and soil blowing are other management concerns. The ponding usually delays tillage in the spring. Surface drains can reduce the wetness, but the closed depressions cannot be easily drained. Crop damage often occurs during years of above normal precipitation. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are birdsfoot trefoil, red clover, reed canarygrass, and creeping foxtail.

This soil is poorly suited to windbreaks because of the wetness. Seedling mortality is severe. The best suited trees and shrubs are those that are tolerant of excess moisture.

The land capability classification is IIIw.

46—Borup loam. This level, poorly drained soil is on lake plains. It is on low flats, in shallow swales, and in depressions. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 250 acres in size.

Typically, the surface layer is black, calcareous loam about 10 inches thick. The subsoil is about 15 inches thick. The upper part is dark grayish brown, calcareous loam, and the lower part is grayish brown, mottled, calcareous very fine sandy loam. The underlying material to a depth of about 60 inches is gray, mottled, calcareous loamy very fine sand. In some areas the surface layer is more silty or is thicker. In a few areas it is noncalcareous. In places the content of fine sand is higher in the upper part of the soil.

Included with this soil in mapping are small areas of Glyndon and Wyndmere soils in the slightly higher landscape positions. Glyndon soils are somewhat poorly drained and moderately well drained, and Wyndmere soils are somewhat poorly drained. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the Borup soil. Available water capacity is high. Organic matter content also is high. Surface runoff is very slow. The seasonal high water table is at a depth of 1.0 to 2.5 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

47—Colvin silty clay loam. This level, poorly drained soil is on lake plains. It is on low flats, in shallow swales, and in depressions. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is black, calcareous silty clay loam about 9 inches thick. The subsoil is olive gray and grayish brown, mottled, calcareous silt loam about 15 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous silt loam. In some areas the surface layer is noncalcareous. In other areas it has a higher content of clay. In places strata of very fine sand or silt 1 to 6 inches thick are in the underlying material.

Included with this soil in mapping are small areas of Augsburg, Bearden, Doran, and Fargo soils. Augsburg and Fargo soils are poorly drained and are in landscape positions similar to those of the Colvin soil. Bearden and Doran soils are somewhat poorly drained and are in the slightly higher areas. Included soils make up about 15 percent of the unit.

Permeability is moderately slow or slow in the Colvin soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

50—Cashel silty clay. This nearly level, somewhat poorly drained soil is on flood plains, typically near the major streams. It is occasionally flooded. Old stream channels commonly meander through areas of this soil. Individual areas are generally elongated and range from 4 to 20 acres in size.

Typically, the surface layer is very dark brown silty clay about 9 inches thick. The next layer is very dark grayish brown and very dark brown silty clay about 20 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay. In some areas the slope is more than 3 percent.

Included with this soil in mapping are small areas of Fargo soils. These soils are poorly drained and are in swales or shallow depressions. They make up about 15 percent of the unit.

Permeability is moderately slow or slow in the Cashel soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

52—Augsburg very fine sandy loam. This level, poorly drained soil is on lake plains. It is on low flats, in shallow swales, and in small depressions. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 250 acres in size.

Typically, the surface layer is black, calcareous very fine sandy loam about 13 inches thick. The subsoil is gray, calcareous very fine sandy loam about 7 inches thick. The upper part of the underlying material is light brownish gray, mottled, calcareous loamy very fine sand. The lower part to a depth of about 60 inches is gray and light gray silty clay. In some places the content of silt is higher in the underlying material. In other places it is lower in the surface layer.

Included with this soil in mapping are small areas of Colvin and Wheatville soils. Colvin soils are poorly drained and are in landscape positions similar to those of the Augsburg soil. Wheatville soils are somewhat poorly drained and are on gentle rises. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Augsburg soil and slow or very slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is very slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

56—Fargo silty clay loam. This nearly level, poorly drained soil is on lake plains. It is typically on flats and low, slightly convex rises. It is subject to rare flooding. Individual areas are irregular in shape and range from 15 to 400 acres in size.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is very dark gray and olive gray clay about 18 inches thick. The underlying material to a depth of about 60 inches is dark gray, mottled, calcareous clay. In some places the surface layer is slightly calcareous. In other places the soil is somewhat poorly drained. In some areas coarse fragments are on the surface. In other areas the content of silt is higher in the underlying material.

Included with this soil in mapping are small areas of Colvin and Wahpeton soils. Colvin soils are poorly drained and are in landscape positions similar to those of the Fargo soil. Wahpeton soils are moderately well drained and are on the higher rises. Included soils make up about 15 percent of the unit.

Permeability is slow in the Fargo soil. Available water capacity is moderate or high. Organic matter content is high. Surface runoff is very slow. The seasonal high water table is within a depth of 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

57A—Fargo silty clay, 0 to 2 percent slopes. This nearly level, poorly drained soil is on lake plains. It is typically on flats, in shallow depressions, and on gentle rises. It is subject to rare flooding. Individual areas are irregular in shape and range from 60 to 600 acres in size.

Typically, the surface layer is black silty clay about 11 inches thick. The subsoil is about 31 inches thick. The upper part is black clay, the next part is dark olive gray clay, and the lower part is olive gray, calcareous clay and silty clay. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous silty clay. In some places the soil has dark buried layers. In other places it has a higher content of clay in the upper part. In some areas coarse fragments are on the surface.

Included with this soil in mapping are small areas of Aazdahl, Colvin, and Wahpeton soils. Aazdahl and Wahpeton soils are moderately well drained and are in the higher landscape positions. Colvin soils are poorly drained and are in landscape positions similar to those of the Fargo soil. Included soils make up about 15 percent of the unit.

Permeability is slow in the Fargo soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5 foot to 3.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

57B—Fargo silty clay, 2 to 6 percent slopes. This gently sloping, poorly drained soil is on lake plains. It typically is on breaks parallel to stream channels. It is subject to rare flooding. Individual areas are elongated and range from 4 to 30 acres in size.

Typically, the surface layer is black and very dark gray silty clay about 9 inches thick. The subsoil is about 17 inches of very dark gray silty clay and clay. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous clay. In places the surface layer is strongly calcareous. In some areas the soil has dark buried layers. In other areas the content of silt is higher in the underlying material.

Included with this soil in mapping are small areas of Aazdahl, Bearden, and Wahpeton soils in the higher landscape positions. Aazdahl and Wahpeton soils are moderately well drained. Bearden soils are somewhat poorly drained. Included soils make up about 15 percent of the unit.

Permeability is slow in the Fargo soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

58—Kittson loam. This nearly level, somewhat poorly drained and moderately well drained soil is on lake plains and moraines. It is typically on slightly convex, irregularly shaped, low rises. Individual areas range from 4 to 40 acres in size.

Typically, the surface soil is black loam about 14 inches thick. The subsoil is dark grayish brown, calcareous loam about 4 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled, calcareous clay loam. In a few areas the depth to sand and gravel is more than 36 inches. In some places stones and boulders are on the surface. In other places the slope is more than 2 percent. In some areas on the lake plains, the soil is subject to rare flooding.

Included with this soil in mapping are small areas of Hamerly, Roliss, and Swenoda soils. Hamerly soils are somewhat poorly drained and moderately well drained and are on the slightly lower rises. Roliss soils are poorly drained and are in the lower landscape positions. Swenoda soils are moderately well drained and are on the higher rises. Included soils make up about 15 percent of the unit.

Permeability is moderate or moderately slow in the Kittson soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. No major hazards or limitations affect cropping, but soil blowing is a problem in bare areas. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is well suited to windbreaks. A wide variety of trees and shrubs can be grown.

The land capability classification is I.

59—Grimstad sandy loam. This nearly level, somewhat poorly drained and moderately well drained soil is on lake plains. It is typically in slightly convex, irregularly shaped areas and on a few gentle rises. Individual areas range from 5 to 85 acres in size.

Typically, the surface layer is black sandy loam about 10 inches thick. The subsoil is about 13 inches of dark gray and dark brown, calcareous sandy loam and loamy fine sand. The upper part of the underlying material is light yellowish brown, mottled, calcareous fine sand. The lower part to a depth of about 60 inches is light olive brown, mottled, calcareous silty clay loam. In a few areas stones and cobbles are on or directly below the surface. Some areas are subject to rare flooding. In places the soil has no contrasting loamy material within 40 inches of the surface.

Included with this soil in mapping are small areas of Foldahl and Rockwell soils. Foldahl soils are moderately well drained and are on the higher, convex parts of the landscape. Rockwell soils are poorly drained and very poorly drained. They are in swales and draws. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Grimstad soil and moderate in the lower part. Available water capacity is moderate. Organic matter content also is moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 4.0 feet.

Most areas are cultivated. Some areas are used for hay or pasture, and a few are left idle. Most of the idle areas are wooded.

This soil is well suited to cropland. The moderate available water capacity and the hazard of soil blowing are the principal concerns in managing the soil as cropland. Improving or maintaining fertility also is a management concern. Minimum tillage, crop residue management, and field shelterbelts help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIs.

60—Glyndon very fine sandy loam. This nearly level, somewhat poorly drained and moderately well drained soil is on lake plains. It is in plane or slightly convex areas. Individual areas are irregular in shape and range from 10 to 600 acres in size.

Typically, the surface layer is black, calcareous very fine sandy loam about 9 inches thick. The subsurface layer is very dark gray, calcareous very fine sandy loam about 4 inches thick. The subsoil is dark gray, calcareous sandy clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive brown and light yellowish brown, mottled, calcareous very fine sandy loam. In some areas a layer of gravel is in the upper part of the underlying material. In other areas stones and boulders are below the surface. In some places sand or coarse sand is below a depth of 40 inches. In other places layers of silt are below a depth of 36 inches.

Included with this soil in mapping are small areas of Borup, Wheatville, and Wyndmere soils. Borup soils are poorly drained and are in the lower, concave areas. Wheatville and Wyndmere soils are somewhat poorly drained and are in landscape positions similar to those of the Glyndon soil. Included soils make up about 15 percent of the unit.

Permeability is moderate or moderately rapid in the Glyndon soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIs.

61—Arveson loam. This nearly level, poorly drained soil is in low areas, shallow swales, and a few slightly convex areas on lake plains and outwash plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is black loam about 11 inches thick. The next 24 inches is dark grayish brown, mottled, calcareous loam and sandy loam. The underlying material to a depth of about 60 inches is dark grayish brown, mottled, calcareous fine sand. In some areas stones and boulders are on the surface. In a few areas the upper part of the surface layer is highly decomposed organic material.

Included with this soil in mapping are small areas of Fossum, Rockwell, and Ulen soils. The poorly drained Fossum and poorly drained and very poorly drained Rockwell soils are in landscape positions similar to those of the Arveson soil. The somewhat poorly drained and moderately well drained Ulen soils are in the higher landscape positions. Included soils make up about 15 percent of the unit.

Permeability is moderate or moderately rapid in the upper part of the Arveson soil and moderately rapid or rapid in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIw.

63—Rockwell loam. This nearly level, poorly drained soil is on lake plains. It is on low flats, in shallow swales, and on a few slightly convex rises. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsoil is gray loam about 6 inches thick. The upper part of the underlying material is olive gray fine sandy loam and light olive gray fine sand. The lower part to a depth of about 60 inches is olive gray, mottled silty clay loam. In a few areas the surface layer is loamy fine sand. In some places the upper part of the underlying material is gravel. In other places stones and boulders are on or directly below the surface. In some areas the upper part of the surface layer is highly decomposed organic material.

Included with this soil in mapping are small areas of Arveson, Grimstad, and Vallers soils. The poorly drained and very poorly drained Arveson and poorly drained Vallers soils are in landscape positions similar to those of the Rockwell soil. The somewhat poorly drained and moderately well drained Grimstad soils are in the slightly higher landscape positions. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid or rapid in the upper part of the Rockwell soil and moderate or moderately slow in the lower part. Available water capacity is moderate or high. Organic matter content is high. Surface runoff is very slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

64—Ulen fine sandy loam. This nearly level, somewhat poorly drained and moderately well drained soil is on gentle rises on lake plains. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is very dark brown fine sandy loam about 11 inches thick. The subsurface layer is very dark grayish brown, calcareous loamy fine sand about 5 inches thick. The subsoil is dark grayish brown, mottled, calcareous loamy fine sand about 7 inches thick. The underlying material to a depth of about 60 inches is pale brown and light brownish gray, mottled fine sand. In some places the soil is less calcareous below the surface layer. In other places the underlying material is mostly very fine sand. In a few areas the surface layer is loam and is less than 8 inches thick. In a few places the soil has dark buried layers. In some areas the slope is more than 2 percent.

Included with this soil in mapping are small areas of Arveson, Flaming, Fossum, and Grimstad soils. Arveson soils are poorly drained and very poorly drained and are in the lower landscape positions. Flaming soils are moderately well drained and are on the higher rises. Fossum soils are poorly drained and are in the lower areas. Grimstad soils are somewhat poorly drained and moderately well drained. They are in landscape positions similar to those of the Ulen soil. Included soils make up about 15 percent of the unit.

Permeability is rapid in the Ulen soil. Available water capacity is moderate. Organic matter content also is moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Many areas are cropped. This soil is fairly well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply (fig. 2). Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. Cultivation

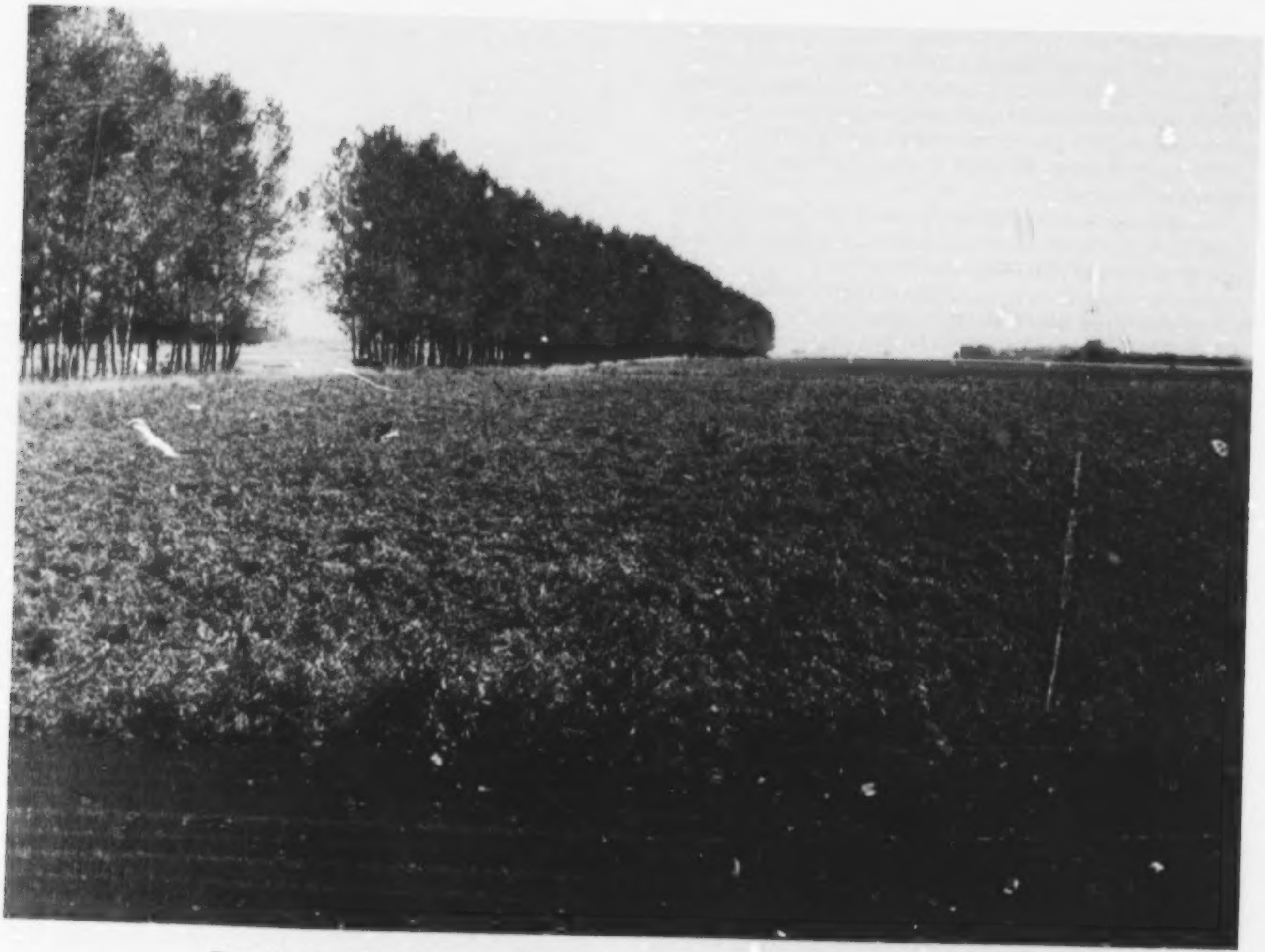


Figure 2.—Potatoes in an area of Ulen fine sandy loam protected by a single-row windbreak.

or applications of herbicide help to remove competing weeds.

The land capability classification is IIIs.

65—Foxhome sandy loam. This nearly level, moderately well drained soil is in slightly convex areas and on low ridges on lake plains. Individual areas are irregular in shape and range from 4 to 30 acres in size.

Typically, the surface layer is black sandy loam about 14 inches thick. The subsoil is about 11 inches thick. It is dark grayish brown sandy loam in the upper part and brown very gravelly sand in the lower part. The upper part of the underlying material is yellowish brown, mottled very gravelly coarse sand. The lower part to a depth of about 60 inches is light olive gray, calcareous silt loam. In some areas the lower part of the subsoil is gravelly sand. In other areas the surface layer is calcareous.

Included with this soil in mapping are small areas of Foldahl, Grimstad, Hamerly, Kittson, and Lohnes soils. Foldahl soils are moderately well drained and are in landscape positions similar to those of the Foxhome soil. Grimstad, Kittson, and Hamerly soils are somewhat poorly drained and moderately well drained. They are in the lower landscape positions. Lohnes soils are well drained and moderately well drained and are in the higher, convex areas. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Foxhome soil. Available water capacity and organic matter content also are moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Many areas are cropped. This soil is fairly well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIs.

66—Flaming loamy fine sand. This nearly level, moderately well drained soil is on lake plains. It is in plane or slightly convex, irregularly shaped areas. Individual areas range from 10 to 200 acres in size.

Typically, the surface layer is black loamy fine sand about 9 inches thick. The subsoil is very dark grayish brown loamy fine sand about 13 inches thick. The underlying material to a depth of about 60 inches is pale brown and grayish brown, mottled fine sand. In some places the soil is calcareous below a depth of 20 inches. In other places the dark surface soil is as much as 24 inches thick. In a few areas the soil has thin layers of gravel. In some small areas the slope is more than 3 percent. In some places stones and boulders are on the surface. In other places the soil is subject to rare flooding.

Included with this soil in mapping are small areas of Arveson, Foldahl, Fossum, and Ulen soils. The poorly drained and very poorly drained Arveson and poorly drained Fossum soils are in the lower landscape positions. The moderately well drained Foldahl soils are in positions similar to those of the Flaming soil. The somewhat poorly drained and moderately well drained Ulen soils are in the slightly lower, convex areas. Included soils make up about 15 percent of the unit.

Permeability is rapid in the Flaming soil. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 4.0 feet.

Some areas are cropped. This soil is poorly suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IVs.

67A—Bearden silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on lake plains. It is on flats, in slightly convex areas, and on gentle rises that have shallow, narrow draws. Individual areas are irregular in shape and range from 15 to 320 acres in size.

Typically, the surface layer is black silt loam about 10 inches thick. The next layer is dark grayish brown and pale brown, mottled, calcareous silt loam about 16 inches thick. The underlying material to a depth of about 60 inches is olive and grayish brown, mottled silty clay loam. In places the part of the profile below the surface layer is stratified silty clay loam, very fine sandy loam, or loamy very fine sand. In a few areas the soil has dark buried layers. In some areas coarse fragments are on or directly below the surface. In other areas the soil is subject to rare flooding.

Included with this soil in mapping are small areas of Aazdahl, Colvin, and Wheatville soils. Aazdahl soils are moderately well drained and are on the higher rises. Colvin soils are poorly drained and are in the lower draws and on flats. Wheatville soils are somewhat poorly drained and are in landscape positions similar to those of the Bearden soil. Included soils make up about 15 percent of the unit.

Permeability is moderately slow in the Bearden soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

67B2—Bearden silt loam, 2 to 6 percent slopes, eroded. This gently sloping, somewhat poorly drained soil is on lake plains. It is typically near streams and along drainageways leading to the streams. Individual areas are elongated and range from 4 to 20 acres in size.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The next layer is brown and grayish brown, calcareous silty clay loam about 23 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled silty clay loam. In some places the surface layer is mixed with the next layer and is calcareous. In other places the content of clay is higher in the surface layer or in the lower part of the underlying material. In a few areas the soil has layers of very fine sand 2 to 6 inches thick. In places the slope is more than 6 percent. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Aazdahl, Glyndon, and Wheatville soils. The moderately well drained Aazdahl soils are in the higher landscape positions. The somewhat poorly drained and moderately well drained Glyndon and somewhat poorly drained Wheatville soils are in landscape positions similar to those of the Bearden soil. Included soils make up about 15 percent of the unit.

Permeability is moderately slow in the Bearden soil. Available water capacity is high. Organic matter content also is high. Surface runoff is medium. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. Soil blowing and water erosion are the principal hazards, and the content of carbonates is a limitation. Soil blowing can be controlled by planting field windbreaks. Leaving protective amounts of crop residue on the surface and seeding cover crops help to control both soil blowing and water erosion. Grassed waterways help to prevent gullying. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates help to prevent chlorosis. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIe.

68—Arveson loam, depressional. This nearly level, very poorly drained soil is in depressions, swales, and draws on lake plains and outwash plains. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black, calcareous loam about 14 inches thick. The next layer is very dark gray, calcareous fine sandy loam about 5 inches thick. The subsoil is gray, calcareous fine sandy loam about 7 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled, calcareous fine sand. In some areas the soil has thin layers of silt. In other areas the dark surface layer is more than 14 inches thick. In some places the soil has dark buried layers. In other places it is loam throughout. In some areas it has stones. In other areas the upper part of the surface layer is highly decomposed organic material.

Included with this soil in mapping are small areas of Deerwood and Rockwell soils. These soils are very poorly drained and are in landscape positions similar to those of the Arveson soil. They make up about 15 percent of the unit.

Permeability is moderate or moderately rapid in the upper part of the Arveson soil and moderately rapid or rapid in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Much of the acreage is idle land that supports sedges, grasses, and lowland brush. Some areas are used as hayland or pasture. This soil is fairly well suited to hay and pasture. The wetness is the principal limitation if the soil is cropped. Because of the runoff from adjacent areas, some ponding usually occurs during the growing season, even if ditches are constructed to remove excess water. When the surface is bare and dry, soil blowing is a hazard. Improving or maintaining fertility also is a management concern. Open field ditches are needed. Conservation tillage, crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that can withstand long periods of extreme wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IVw.

71—Fossum loamy fine sand. This level, poorly drained soil is on lake plains. It is on low flats, in shallow swales, and in a few slightly convex areas. Individual areas are irregular in shape and range from 15 to 80 acres in size.

Typically, the surface layer is very dark brown loamy fine sand about 8 inches thick. The next layer is very dark gray and dark grayish brown, calcareous loamy fine sand about 12 inches thick. The upper part of the underlying material is light brownish gray, mottled fine sand. The lower part to a depth of about 60 inches is light gray sand. In some areas the surface layer is loam. In other areas the underlying material contains gravel. In a few areas the soil is noncalcareous. In some places the upper part of the surface layer is highly decomposed organic material. In other places the soil has stones. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Arveson, Flaming, and Rockwell soils. Arveson and Rockwell soils are poorly drained and very poorly drained and are in landscape positions similar to those of the Fossum soil. Flaming soils are moderately well drained and are in the higher landscape positions. Included soils make up about 15 percent of the unit.

Permeability is rapid in the Fossum soil. Available water capacity is low. Organic matter content is moderate. Surface runoff is very slow. The depth to a seasonal high water table is 1.0 to 2.5 feet.

Much of the acreage is hayland or pasture. Some areas are cropped. This soil is fairly well suited to hay and pasture and poorly suited to cropland. The wetness is the principal limitation if the soil is cropped. Because of the runoff from adjacent areas, some ponding usually occurs, even if ditches are constructed to remove excess water. When the surface is bare and dry, soil blowing is a hazard. Improving or maintaining fertility also is a management concern. Open field ditches are needed. Conservation tillage, crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that can withstand long periods of extreme wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IVw.

93—Bearden silty clay loam. This nearly level, somewhat poorly drained soil is on lake plains. It is on flats, in slightly convex areas, and on a few gentle rises that have shallow, narrow draws. Individual areas are irregular in shape and range from 15 to 500 acres in size.

Typically, the surface layer is black, calcareous silty clay loam about 9 inches thick. The subsurface layer is very dark gray, calcareous silty clay loam about 6 inches thick. The subsoil is grayish brown, calcareous silt loam about 18 inches thick. The underlying material to a depth of about 60 inches is light olive brown and grayish brown, mottled, calcareous silt loam. In some areas the content of silt is higher in the surface layer. In other areas layers of clay are below a depth of 36 inches. In a few areas the surface layer is noncalcareous.

Included with this soil in mapping are small areas of Aazdahl, Colvin, Fargo, and Wheatville soils. Aazdahl soils are moderately well drained and are in the higher landscape positions. Colvin and Fargo soils are poorly drained and are in the lower draws and on flats. Wheatville soils are somewhat poorly drained and are in landscape positions similar to those of the Bearden soil. Included soils make up about 15 percent of the unit.

Permeability is moderately slow in the Bearden soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

107—Winger silt loam. This nearly level, poorly drained soil is on ground moraines. It is on flats and in slightly concave areas. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black, calcareous silt loam about 10 inches thick. The subsoil is dark gray, calcareous silt loam about 22 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled, calcareous clay loam. In some places the surface layer is noncalcareous. In other places the underlying material has a pebble layer as much as 6 inches thick. In some areas the upper part of the surface layer is highly decomposed organic material.

Included with this soil in mapping are small areas of McIntosh and Vallers soils. McIntosh soils are somewhat poorly drained and moderately well drained and are in the slightly higher landscape positions. Vallers soils are poorly drained and are in positions similar to those of the Winger soil. Included soils make up about 15 percent of the unit.

Permeability is moderate in the upper part of the Winger soil and moderate or moderately slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

108—McIntosh silt loam. This nearly level, somewhat poorly drained and moderately well drained soil is on ground moraines. It is in swales and on slight rises. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black silt loam about 7 inches thick. The subsurface layer is very dark gray, calcareous silt loam about 5 inches thick. The subsoil is dark gray, calcareous silt loam about 13 inches thick. The underlying material to a depth of about 60 inches is light olive brown, mottled, calcareous clay loam. In places a pebble layer as much as 6 inches thick is in the upper part of the underlying material. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Hamerly and Winger soils. Hamerly soils are somewhat poorly drained and moderately well drained and are in landscape positions similar to those of the McIntosh soil. Winger soils are poorly drained and are in the lower positions. Included soils make up about 15 percent of the unit.

Permeability is moderate in the upper part of the McIntosh soil and moderate or moderately slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 3 to 6 feet.

Most areas of this soil are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

157A—Wahpeton clay, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on flats on stream terraces. It is occasionally flooded. Individual areas are irregular in shape, are oriented in a northwest-southeast direction, and range from 10 to 100 acres in size.

Typically, the surface layer is black clay about 12 inches thick. The next 8 inches is very dark grayish brown clay. Below this is a buried surface layer of very dark brown clay about 7 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown, mottled silty clay. In some areas the soil has no dark buried layers. In other areas the surface layer is less than 12 inches thick. In a few areas the underlying material has layers of loam as much as 12 inches thick.

Included with this soil in mapping are small areas of Aazdahl and Fargo soils. Aazdahl soils are moderately well drained and are on rises along stream terraces. Fargo soils are poorly drained and are in the lower landscape positions. Included soils make up about 15 percent of the unit.

Permeability is moderate or moderately slow in the Wahpeton soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow or medium.

Most areas are cropped. This soil is well suited to cropland and pasture. Wetness is the principal limitation. It can delay fieldwork. The occasional flooding and soil blowing are hazards. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, birdsfoot trefoil, smooth bromegrass, and orchardgrass.

This soil is well suited to windbreaks. A wide variety of trees and shrubs can be grown.

The land capability classification is II[illegible]

157B—Wahpeton clay, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on the sides of terraces along the major streams and drainageways. It is occasionally flooded. Individual areas are elongated and range from 4 to 30 acres in size.

Typically, the surface soil is about 27 inches of black and very dark gray silty clay and clay. The underlying material to a depth of about 60 inches is dark gray and dark grayish brown, mottled clay. In some areas the soil has dark buried layers. In a few areas the content of clay is lower in the underlying material. In places the slope is more than 6 percent.

Included with this soil in mapping are small areas of Aazdahl and Fargo soils. Aazdahl soils are moderately well drained and are on rises along stream terraces. Fargo soils are poorly drained and are in the lower landscape positions. Included soils make up about 15 percent of the unit.

Permeability is moderate or moderately slow in the Wahpeton soil. Available water capacity is high. Organic matter content also is high. Surface runoff is medium.

Most areas are cropped. This soil is well suited to cropland and pasture. Soil blowing and water erosion are the principal hazards. Soil blowing can be controlled by planting field windbreaks. Leaving protective amounts of crop residue on the surface and seeding cover crops help to control both soil blowing and water erosion. Grassed waterways help to prevent gullying. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is well suited to windbreaks. A wide variety of trees and shrubs can be grown.

The land capability classification is IIe.

184A—Hamerly clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on uplands. It is typically on flats and on a few low rises and knobs. Individual areas are irregular in shape and range from 15 to 600 acres in size.

Typically, the surface layer is black, calcareous clay loam about 9 inches thick. The subsoil is calcareous clay loam about 16 inches thick. It is grayish brown in the upper part and light olive brown in the lower part. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous clay loam. The subsoil and underlying material have pockets of gypsum crystals. The soil commonly has coarse fragments. In some places it has a higher content of clay and silt. In other places the surface layer is noncalcareous. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Aazdahl, Clearwater, and Doran soils. Aazdahl soils are moderately well drained and are on the higher rises and knobs. Clearwater soils are poorly drained and are in the lower landscape positions. Doran soils are somewhat poorly drained and are in positions similar to those of the Hamerly soil. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Hamerly soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

184B—Hamerly loam, 1 to 4 percent slopes. This nearly level and gently undulating, moderately well drained soil is on uplands. It is on irregularly shaped flats and in slightly convex areas. Individual areas range from 10 to 300 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is very dark grayish brown, calcareous loam about 4 inches thick. The subsoil is very pale brown, calcareous loam about 7 inches thick. The underlying material to a depth of about 60 inches is light brownish gray, mottled loam. The soil commonly has coarse fragments. In some areas the surface layer is less than 9 inches thick. In other areas the underlying material has layers of sand or of sand and gravel below a depth of 30 inches. In places the surface soil is more than 16 inches thick.

Included with this soil in mapping are small areas of Kittson, McIntosh, Roliss, and Vallers soils. Kittson and McIntosh soils are somewhat poorly drained and moderately well drained. They are in landscape positions similar to those of the Hamerly soil. Roliss and Vallers soils are poorly drained and are in the lower positions. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Hamerly soil. Available water capacity is high. Organic matter content also is high. Surface runoff is medium or slow. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. Soil blowing and water erosion are the principal hazards, and the content of carbonates is a limitation. Soil blowing can be controlled by planting field windbreaks. Leaving protective amounts of crop residue on the surface and seeding cover crops help to control both soil blowing and water erosion. Grassed waterways help to prevent gullying. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIe.

187—Haug muck. This level, very poorly drained soil is in depressions, swales, and draws on lake plains and ground moraines. It is subject to rare flooding and to ponding. Individual areas are irregular in shape and range from 3 to 80 acres in size.

Typically, the surface layer is black, calcareous muck about 14 inches thick. The subsurface layer is very dark gray, slightly calcareous loam about 6 inches thick. The underlying material to a depth of about 60 inches is gray, mottled, calcareous silt loam. In some areas stones are below the surface layer. In other areas the organic surface layer is more than 16 inches thick.

Included with this soil in mapping are small areas of Arveson, Deerwood, Rockwell, and Vallers soils. Arveson, Deerwood, and Rockwell soils are in landscape positions similar to those of the Haug soil. Arveson and Rockwell soils are poorly drained and very poorly drained. Deerwood soils are very poorly drained. Vallers soils are poorly drained and are on the rims of depressions. Included soils make up about 15 percent of the unit.

Permeability and available water capacity are moderate in the Haug soil. Organic matter content is very high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 3 feet below the surface.

Much of the acreage is idle land that supports sedges, grasses, and lowland brush. Some areas are used as hayland or pasture. This soil is fairly well suited to hay and pasture. It is poorly suited to cropland. The wetness is the principal limitation if the soil is cropped. Because of the runoff from adjacent areas, some ponding usually occurs during the growing season, even if ditches are constructed to remove excess water. When the surface is bare and dry, soil blowing is a hazard. Improving or maintaining fertility also is a management concern. Open field ditches are needed. Conservation tillage, crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that can withstand long periods of extreme wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIw.

236—Vallers loam. This nearly level, poorly drained soil is on low flats, in shallow swales, and on the rims of depressions on ground moraines. It is subject to rare flooding. Individual areas are irregular in shape and range from 3 to 200 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is very dark gray, calcareous clay loam about 6 inches thick. The subsoil is dark gray, calcareous clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled clay loam. In some areas the surface layer is mixed with the subsurface layer and is very strongly calcareous. In other areas the underlying material has layers of gravel and sand less than 6 inches thick. In places the surface soil is more than 24 inches thick. In a few areas stones and boulders are on or directly below the surface.

Included with this soil in mapping are small areas of Hamerly, Kittson, and Rockwell soils. Hamerly and Kittson soils are somewhat poorly drained and moderately well drained and are on the higher rises. Rockwell soils are poorly drained and very poorly drained and are in landscape positions similar to those of the Vallers soil. Included soils make up about 15 percent of the unit.

Permeability is moderately slow in the Vallers soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 1.0 to 2.5 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

245B—Lohnes loamy sand, 1 to 6 percent slopes. This nearly level and gently sloping, well drained soil is on lake plains and outwash plains. It is on the crest and upper sides of ridges. Individual areas are irregular in shape and range from 10 to 120 acres in size.

Typically, the surface layer is black loamy sand about 10 inches thick. The subsurface layer is very dark grayish brown loamy coarse sand about 6 inches thick. The subsoil is brown loamy sand about 6 inches thick. The underlying material to a depth of about 60 inches is light olive brown, calcareous gravelly loamy sand and gravelly coarse sand. In some places the lower part of the underlying material is loam. In other places stones and boulders are on or directly below the surface. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Sioux soils. These soils are excessively drained and are on the crest of slopes. They make up about 10 percent of the unit.

Permeability is rapid in the Lohnes soil. Available water capacity is low. Organic matter content is moderately low. Surface runoff is very slow.

Some areas are cropped. This soil is poorly suited to cropland. Soil blowing is the main hazard (fig. 3), and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by the low available water capacity. During the early years of establishment, leaving some vegetation on the surface or mulching helps to control soil blowing and conserves moisture.

The land capability classification is IVs.

290B—Rothsay silt loam, 2 to 4 percent slopes. This gently undulating, well drained soil is on gentle rises and side slopes on lake plains and moraines. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is black silt loam about 11 inches thick. The subsoil is silt loam about 10 inches thick. It is dark brown in the upper part and pale brown and calcareous in the lower part. The upper part of the underlying material is yellowish brown, calcareous silt loam. The lower part to a depth of about 60 inches is light yellowish brown, calcareous very fine sandy loam. In some places the soil has a higher content of fine sand and very fine sand. In other places it has a higher content of clay. In some areas moderate erosion has removed part of the topsoil.

Included with this soil in mapping are small areas of Darnen, Hantho, and Zell soils. Darnen and Hantho soils are moderately well drained and are on the lower side slopes. Zell soils are well drained and are on the upper side slopes and the tops of rises. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Rothsay soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow or medium.

Most areas are cropped. This soil is well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIe.

290B2—Rothsay silt loam, 2 to 6 percent slopes, eroded. This gently undulating, well drained soil is on gentle rises and side slopes on lake plains and moraines. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsoil is dark brown silt loam about 8 inches thick. The underlying material to a depth of about 60 inches is calcareous very fine sandy loam. It is yellowish brown in the upper part and pale brown in the lower part. In some places the soil has a higher content of fine sand and very fine sand. In other places it has a higher content of clay.

Included with this soil in mapping are small areas of Darnen and Hantho soils. These soils are moderately well drained and are on the lower side slopes. They make up about 15 percent of the unit.

Permeability is moderate in the Rothsay soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow or medium.

Most areas are cropped. This soil is well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

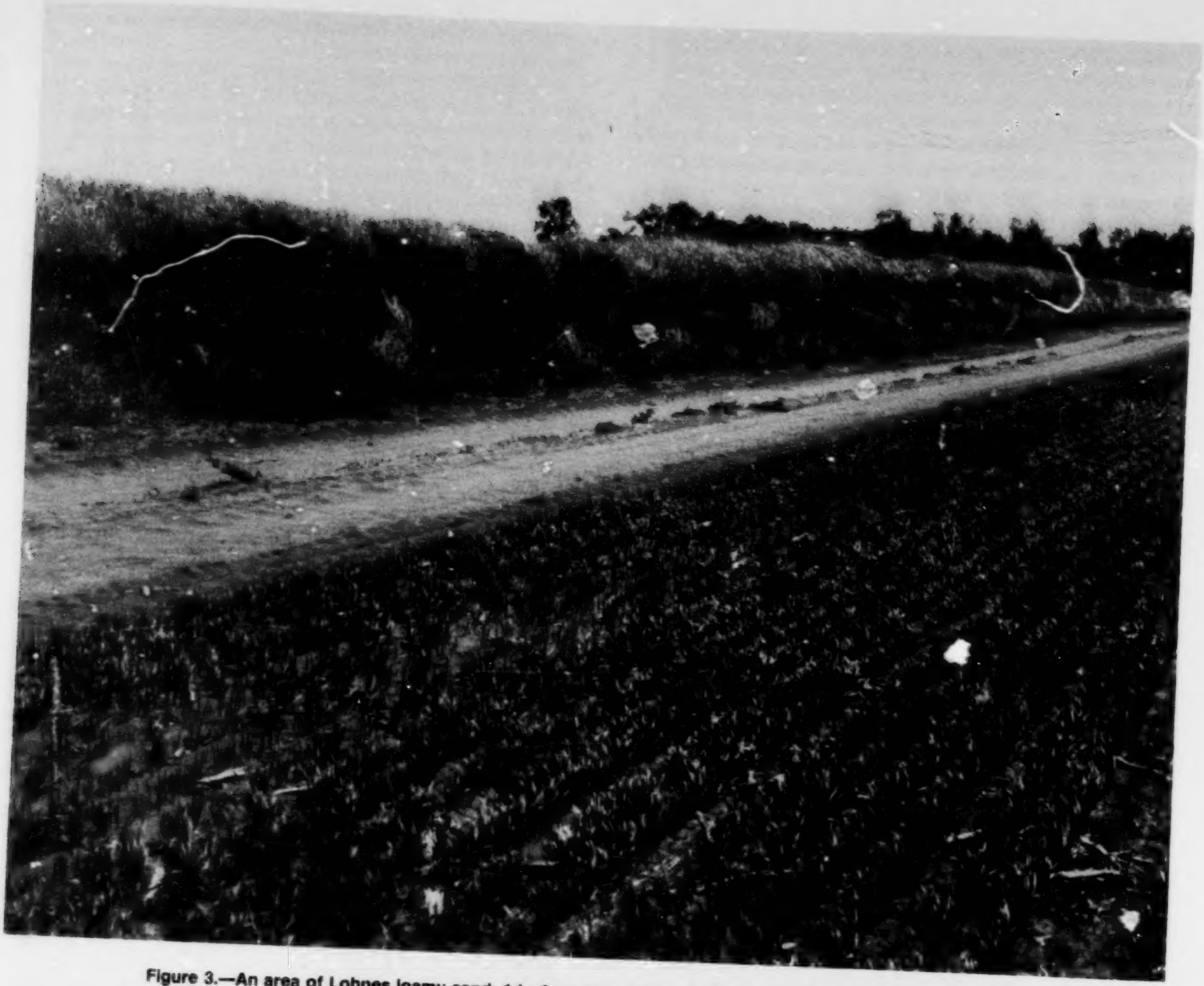


Figure 3.—An area of Lohnes loamy sand, 1 to 6 percent slopes, that has been damaged by soil blowing.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIe.

293B—Swenoda fine sandy loam, 1 to 4 percent slopes. This nearly level and gently sloping, moderately well drained soil is on uplands. Individual areas are irregular in shape and range from 4 to 80 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 13 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is about 17 inches thick. It is dark brown fine sandy loam in the upper part and light yellowish brown silt loam in the lower part. The underlying material to a depth of about 60 inches is light yellowish brown, mottled silt loam. In some areas the soil is dark to a depth of less than 16 inches. In a few areas a layer of sand is in the lower part of the subsoil. In some places stones are on the surface. In other places the slope is more than 4 percent.

Included with this soil in mapping are small areas of Foldahl and Kittson soils. Foldahl soils are moderately well drained and are in landscape positions similar to those of the Swenoda soil. Kittson soils are somewhat poorly drained and moderately well drained and are on the lower slopes. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderate or moderately slow in the lower part. Available water capacity is moderate. Organic matter content also is moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 4.0 feet.

Most areas are cropped. This soil is well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIe.

335—Urness mucky silt loam. This level, very poorly drained soil is in depressions, in swales, and on broad, low flats in lake basins. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 4 to 160 acres in size.

Typically, the surface layer is black mucky silt loam about 10 inches thick. The upper part of the underlying material is stratified black and very dark gray, mottled mucky silt loam. The lower part to a depth of about 60 inches is dark gray, calcareous clay loam. In some areas layers of fine sand are in the mucky sediments. In other areas the soil has layers of highly decomposed material derived from reeds and sedges.

Included with this soil in mapping are small areas of Quam soils. These soils are very poorly drained and are in landscape positions similar to those of the Urness soil. They make up about 10 percent of the unit.

Permeability is moderate or moderately slow in the Urness soil. Available water capacity is high or very high. Organic matter content is very high. Surface runoff is ponded. The seasonal high water table is 2 feet above to 1 foot below the surface.

Much of the acreage is idle land that supports sedges, grasses, and lowland brush. Some areas are used as hayland or pasture (fig. 4). This soil is fairly well suited to hay and pasture. The wetness is the principal limitation if the soil is cropped. Because of the runoff from adjacent areas, some ponding usually occurs during the growing season, even if ditches are constructed to remove excess water. When the surface is bare and dry, soil blowing is a hazard. Improving or maintaining fertility also is a management concern. Open field ditches are needed. Conservation tillage, crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that can withstand long periods of extreme wetness. Seedling mortality is severe because of the wetness. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIw.

343A—Wheatville silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on lake plains. It is on flats and in slightly convex areas. Individual areas are irregular in shape and range from 10 to 1,500 acres in size.

Typically, the surface layer is black, calcareous silt loam about 10 inches thick. The subsoil is dark gray, calcareous very fine sandy loam about 7 inches thick. The upper part of the underlying material is light yellowish brown, mottled, calcareous loamy very fine sand. The lower part to a depth of about 60 inches is olive, mottled, calcareous silty clay. In some areas the lower part of the underlying material is silty clay loam. In a few areas the surface layer is noncalcareous. In some places, the surface layer is thicker and the subsoil has dark buried layers. In other places stones and boulders are on or directly below the surface. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Augsburg, Bearden, and Glyndon soils. Augsburg soils are poorly drained and are in the slightly lower landscape positions. Bearden and Glyndon soils are in positions similar to those of the Wheatville soil. Bearden soils are somewhat poorly drained, and Glyndon soils are somewhat poorly drained and moderately well drained. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Wheatville soil and slow in the lower part. Available water capacity is moderate or high. Organic matter content is high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth

Figure 4.—A pastured area of Urness mucky silt loam.

bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

343B2—Wheatville very fine sandy loam, 2 to 6 percent slopes, eroded. This gently sloping, somewhat poorly drained soil is on rises on lake plains. It is typically near streams and along drainageways leading to the streams. Erosion has exposed the subsoil in places. Individual areas range from 4 to 20 acres in size.

Typically, the surface layer is very dark gray very fine sandy loam about 10 inches thick. The subsoil is brown and pale brown, calcareous very fine sandy loam about 7 inches thick. The upper part of the underlying material is pale brown, mottled very fine sandy loam. The lower part to a depth of about 60 inches is gray, mottled clay. In some areas the surface layer is mixed with the subsoil and is calcareous. In other areas the very fine sandy loam in the surface layer and subsoil is less than 16 inches thick. In a few areas the soil has dark buried layers. In some places stratified silt loam, silty clay loam, and silty clay are in the lower part of the underlying material. In other places the slope is more than 6 percent. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of the somewhat poorly drained Bearden and somewhat poorly drained and moderately well drained Glyndon soils. These soils are in landscape positions similar to those of the Wheatville soil. They make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Wheatville soil and slow in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. Soil blowing and water erosion are the principal hazards, and the content of carbonates is a limitation. Soil blowing can be controlled by planting field windbreaks. Leaving protective amounts of crop residue on the surface and seeding cover crops help to control both soil blowing and water erosion. Grassed waterways help to prevent gullying. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIe.

344—Quam silt loam. This nearly level, very poorly drained soil is in depressions and swales on ground moraines. These depressions and swales are at least partially filled with colluvial deposits. The soil is subject to ponding. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface soil is about 32 inches thick. It is black. It is silt loam in the upper part, clay loam in the next part, and silty clay loam in the lower part. The upper part of the underlying material is dark gray, mottled silty clay loam. The lower part to a depth of about 60 inches is olive gray, mottled silt loam. In places the surface soil is calcareous. In some areas the content of clay is higher in the underlying material.

Included with this soil in mapping are small areas of Urness soils. These soils are very poorly drained and are in landscape positions similar to those of the Quam soil. They make up about 10 percent of the unit.

Permeability is moderately slow in the Quam soil. Available water capacity is high. Organic matter content is very high. Surface runoff is very slow or ponded. The seasonal high water table is 2 feet above to 1 foot below the surface.

Most areas are cropped. This soil is fairly well suited to cropland and well suited to pasture. The wetness is the principal limitation. Ponding and soil blowing are other management concerns. The ponding usually delays tillage in the spring. Surface drains reduce the wetness, but the closed depressions cannot be easily drained. Crop damage often occurs during years of above normal precipitation. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are birdsfoot trefoil, red clover, reed canarygrass, and creeping foxtail.

This soil is poorly suited to windbreaks because of the wetness. Seedling mortality is severe. The best suited trees and shrubs are those that are tolerant of excess moisture.

The land capability classification is IIIw.

359—Lamoure silty clay loam, frequently flooded. This nearly level, poorly drained soil commonly is in meander channels on flood plains. It is flooded several times during most growing seasons. Individual areas range from 3 to 30 acres in size.

Typically, the surface layer is black, calcareous silty clay loam about 34 inches thick. The underlying material to a depth of about 60 inches is dark gray, mottled silt loam. In some places the soil has a higher content of fine sand within 40 inches of the surface. In other places a buried surface layer is in the underlying material. In some areas where channel scars are evident, slopes are short and are as much as 8 percent. In a few areas the underlying material has more clay.

Included with this soil in mapping are areas of Haplaquolls and Histosols, ponded. These very poorly drained soils generally support marsh vegetation. They are in low areas adjacent to streams. They make up about 15 percent of the unit.

Permeability is moderate in the Lamoure soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is within a depth of 2 feet.

Much of the acreage is idle land that supports scattered trees and brush. Because of the flooding and the wetness, this soil is generally unsuitable as cropland. It is suited to wetland wildlife habitat and to limited grazing.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the extreme wetness and the flooding. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is VIw.

402B—Sioux sandy loam, 1 to 6 percent slopes. This nearly level and gently sloping, excessively drained soil is on outwash plains. It is on the crest and upper parts of ridges and in convex areas that are irregularly shaped. Individual areas range from 10 to 200 acres in size.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown gravelly loamy coarse sand about 3 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown gravelly coarse sand. In some areas stones and boulders are on or directly below the surface. In a few areas moderate erosion has removed part of the topsoil. In places the content of silt and clay is higher in the surface soil or in the underlying material.

Included with this soil in mapping are small areas of Flaming, Lohnes, and Osakis soils on side slopes. Flaming and Osakis soils are moderately well drained, and Lohnes soils are moderately well drained and well drained. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid or very rapid in the Sioux soil. Available water capacity is low. Organic matter content is moderately low. Surface runoff is slow.

Most areas are used as hayland or pasture. Other areas are idle. Because of droughtiness, this soil is generally unsuited to cropland and to the trees and shrubs grown as windbreaks and environmental plantings. Seedling mortality is severe because of the moisture stress caused by the low available water capacity. Onsite investigation may indicate that certain trees and shrubs can be established if special management is applied.

The land capability classification is VIs.

403—Viking silty clay. This nearly level, poorly drained soil is in plane or slightly concave areas on lake plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 4 to 200 acres in size.

Typically, the surface layer is about 12 inches thick. It is black. It is silty clay in the upper part and clay in the lower part. The subsoil is very dark grayish brown and dark grayish brown clay about 15 inches thick. The underlying material to a depth of about 60 inches is dark gray and olive gray, mottled, calcareous clay. In some areas it is not mottled. In other areas it has a lower content of clay. In a few areas the soil is calcareous within 16 inches of the surface.

Included with this soil in mapping are small areas of Clearwater, Donaldson, Fargo, and Northcote soils. Clearwater, Fargo, and Northcote soils are poorly drained and are in landscape positions similar to those of the Viking soil. Donaldson soils are somewhat poorly drained and moderately well drained and are in the slightly higher positions. Included soils make up about 15 percent of the unit.

Permeability is very slow in the Viking soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

413—Osakis sandy loam. This nearly level, moderately well drained soil is on plane or slightly concave slopes on outwash plains. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsurface layer is very dark brown sandy loam about 7 inches thick. The subsoil is about 9 inches thick. It is very dark grayish brown sandy loam in the upper part and brown loamy sand in the lower part. The upper part of the underlying material is dark grayish brown, mottled very gravelly loamy sand. The lower part to a depth of about 60 inches is dark grayish brown gravelly sand. In some areas the soil is dark to a depth of less than 16 inches. In a few areas it is calcareous. In places the content of sand is higher in the surface layer.

Included with this soil in mapping are small areas of Foxhome, Kittson, Lohnes, and Sioux soils. Foxhome soils are moderately well drained, and Lohnes soils are well drained and moderately well drained. Both of these soils are on side slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in landscape positions similar to those of the Osakis soil. Sioux soils are excessively drained and are in the higher, more sloping areas. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Osakis soil and rapid in the lower part. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow. The depth to a seasonal high water table is 3 to 6 feet.

Many areas are cropped. This soil is fairly well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIs.

418—Lamoure silty clay loam, occasionally flooded. This nearly level, poorly drained soil is on low flats on flood plains. It is occasionally flooded for short periods. Individual areas are generally elongated and are parallel to stream channels. They range from 4 to 25 acres in size.

Typically, the surface soil is black silty clay loam about 18 inches thick. The next layer is very dark gray silty clay loam about 14 inches thick. The upper part of the underlying material is grayish brown and gray, mottled silty clay loam and silt loam. The lower part to a depth of about 60 inches is dark gray, stratified silt loam and very fine sand. In some areas the slope is more than 3 percent. In other areas a buried surface layer is in the underlying material.

Included with this soil in mapping are small areas of Cashel, Clearwater, Lindaas, and Rockwell soils. Cashel soils are somewhat poorly drained and are in the higher landscape positions. Clearwater, Lindaas, and Rockwell soils are in positions similar to those of the Lamoure soil. Clearwater and Lindaas soils are poorly drained, and Rockwell soils are poorly drained and very poorly drained. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Lamoure soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is within a depth of 2 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. It can help to remove floodwater. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Unless a plant cover protects the surface, floodwater can cause severe erosion and can damage seedlings. Site preparation should be limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

425—Donaldson very fine sandy loam. This nearly level, somewhat poorly drained and moderately well drained soil is on lake plains. It is typically in slightly convex areas and on gentle rises. Individual areas are irregular in shape and range from 10 to 400 acres in size.

Typically, the surface layer is black very fine sandy loam about 9 inches thick. The subsoil is dark grayish brown, mottled very fine sandy loam about 10 inches thick. The upper part of the underlying material is light yellowish brown, mottled loamy very fine sand. The lower part to a depth of about 60 inches is dark gray, mottled, calcareous silty clay. In some areas pebbles and cobbles are in the upper part of the underlying material.

Included with this soil in mapping are small areas of Aazdahl, Elmville, Foldahl, Galchutt, and Wheatville soils. Aazdahl and Foldahl soils are moderately well drained and are on the higher rises. Elmville, Galchutt, and Wheatville soils are somewhat poorly drained and are in the slightly lower areas and on flats. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Donaldson soil and slow in the lower part. Available water capacity is moderate or high. Organic matter content is moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. No major hazards or limitations affect cropping, but soil blowing is a problem in bare areas. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is well suited to windbreaks. A wide variety of trees and shrubs can be grown.

The land capability classification is I.

426—Foldahl loamy fine sand. This nearly level, moderately well drained soil is in slightly convex areas on lake plains. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is very dark brown loamy fine sand about 10 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 3 inches thick. The subsoil is dark yellowish brown, mottled fine sand about 9 inches thick. The underlying material to a depth of about 60 inches is light brownish gray and pale brown, mottled loam. In some areas the dark surface soil is more than 16 inches thick. In a few areas stones and boulders are on or directly below the surface. In some places they are in the upper part of the underlying material. In other places layers of gravel are in the upper part of the soil. In some areas the soil is well drained. In other areas it is subject to rare flooding.

Included with this soil in mapping are small areas of Flaming, Grimstad, and Swenoda soils. Flaming and Swenoda soils are moderately well drained and are in landscape positions similar to those of the Foldahl soil. Grimstad soils are somewhat poorly drained and are in the lower positions. Included soils make up about 15 percent of the unit.

Permeability is rapid in the upper part of the Foldahl soil and moderately slow or moderate in the lower part. Available water capacity is moderate or low. Organic matter content is moderately low or moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 4.0 feet.

Some areas are cropped. This soil is fairly well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIs.

429—Northcote clay. This nearly level, poorly drained soil is on plane or slightly concave slopes on lake plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 60 to 1,500 acres in size.

Typically, the surface layer is black clay about 9 inches thick. The subsoil is very dark gray and dark olive gray clay about 11 inches thick. The underlying material to a depth of about 60 inches is dark gray and olive gray, mottled clay. In some areas the content of clay is lower in the surface layer. In other areas pebbles are on the surface.

Included with this soil in mapping are small areas of Clearwater, Colvin, Fargo, and Viking soils. These soils are poorly drained and are in landscape positions similar to those of the Northcote soil. They make up about 15 percent of the unit.

Permeability is slow in the Northcote soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is very slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility and tilth is an additional management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

435—Syrene sandy loam. This nearly level, poorly drained soil is on lake plains. It is on low flats, in shallow swales, and on a few gentle rises. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is black sandy loam about 9 inches thick. The subsoil is calcareous sandy loam about 9 inches thick. The upper part is dark gray, and the lower part is gray. The underlying material to a depth of about 60 inches is light brownish gray and olive gray, mottled, calcareous gravelly sand and sand. In some areas a layer of loam is at a depth of 36 to 50 inches. In a few areas the content of organic matter in the surface layer is more than 30 percent. In places stones and boulders are on or directly below the surface.

Included with this soil in mapping are small areas of Arveson and Rockwell soils. These soils are poorly drained and very poorly drained and are in landscape positions similar to those of the Syrene soil. They make up about 15 percent of the unit.

Permeability is rapid in the Syrene soil. Available water capacity is moderate or low. Organic matter content is high. Surface runoff is very slow or slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are used for hay or pasture. A few are cropped. This soil is poorly suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IVw.

494—Darnen silt loam. This nearly level, moderately well drained soil is in swales on moraines. Individual areas are elongated or irregular in shape and range from 3 to 20 acres in size.

Typically, the surface soil is silt loam about 24 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is dark yellowish brown clay loam about 11 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown clay loam. In some places layers of sand and gravel less than 6 inches thick are between the underlying material and the subsoil. In other places the surface layer is calcareous. In a few places the content of silt is higher in the underlying material. In some areas the soil is somewhat poorly drained and may be wet when runoff from the adjacent slopes is excessive.

Included with this soil in mapping are small areas of Barnes, Hantho, and Kittson soils. Barnes soils are well drained and are on swells and gentle rises. Hantho soils are moderately well drained and are in landscape positions similar to those of the Darnen soil. Kittson soils are somewhat poorly drained and moderately well drained and are in the lower swales. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Darnen soil. Available water capacity is high. Organic matter content also is high. Surface runoff is medium. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. No major hazards or limitations affect cropping, but soil blowing is a problem in bare areas. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is well suited to windbreaks. A wide variety of trees and shrubs can be grown.

The land capability classification is I.

497—Hantho silt loam. This nearly level, moderately well drained soil is in swales on lake plains. Individual areas are irregular in shape and range from 4 to 50 acres in size.

Typically, the surface soil is black silt loam about 18 inches thick. The subsoil is silt loam about 14 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The underlying material to a depth of about 60 inches is calcareous. It is olive brown silt loam in the upper part, light olive brown loam in the next part, and light brownish gray silt loam in the lower part. In some areas the soil is somewhat poorly drained.

Included with this soil in mapping are small areas of Darnen, Kittson, and Rothsay soils. Darnen soils are moderately well drained, and Kittson soils are moderately well drained and somewhat poorly drained. Both of these soils are in landscape positions similar to those of the Hantho soil. Rothsay soils are well drained and are in the higher positions. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Hantho soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 3 to 5 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. No major hazards or limitations affect cropping, but soil blowing is a problem in bare areas. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, smooth bromegrass, and orchardgrass.

This soil is well suited to windbreaks. A wide variety of trees and shrubs can be grown.

The land capability classification is I.

508—Wyndmere fine sandy loam. This nearly level, somewhat poorly drained soil is on deltas and lake plains. It is on flats and gentle rises. Individual areas are irregular in shape and range from 20 to 500 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 11 inches thick. The subsoil is calcareous fine sandy loam about 16 inches thick. It is dark gray in the upper part and grayish brown in the lower part. The underlying material to a depth of about 60 inches is mottled, calcareous fine sandy loam. It is light yellowish brown in the upper part and light olive brown in the lower part. In places the soil has dark buried layers and has a thicker surface layer. In a few areas thin layers of gravel are in the underlying material. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Borup, Elmville, and Ulen soils. Borup soils are poorly drained and are in the lower landscape positions. Elmville soils are somewhat poorly drained, and Ulen soils are somewhat poorly drained and moderately well drained. Both of these soils are in landscape positions similar to those of the Wyndmere soil. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the Wyndmere soil. Available water capacity is moderate or high. Organic matter content is high or very high. Surface runoff is slow. The depth to a seasonal high water table is 2 to 5 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

510—Elmville very fine sandy loam. This nearly level, somewhat poorly drained soil is in lake basins. It is on flats and gentle rises. Individual areas are irregular in shape and range from 15 to 500 acres in size.

Typically, the surface layer is black, calcareous very fine sandy loam about 9 inches thick. The subsurface layer is very dark gray, calcareous very fine sandy loam about 6 inches thick. The subsoil is grayish brown, calcareous loamy very fine sand about 6 inches thick. The underlying material to a depth of about 60 inches is calcareous. It is light olive brown loamy very fine sand in the upper part; light yellowish brown, mottled very fine sand in the next part; and olive gray, mottled silty clay in the lower part. In a few areas moderate erosion has removed part of the topsoil. In some areas layers of sand are in the underlying material. In areas near natural drainageways, the soil has a buried surface layer. In some places the lower part of the underlying material is clay. In other places stones are on or directly below the surface. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Augsburg, Donaldson, Lindaas, Wheatville, and Wyndmere soils. Augsburg and Lindaas soils are poorly drained and are in the lower landscape positions. Donaldson soils are somewhat poorly drained and moderately well drained and are on the higher rises. Wheatville and Wyndmere soils are somewhat poorly drained and are in landscape positions similar to those of the Elmville soil. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Elmville soil and slow in the lower part. Available water capacity is moderate or high. Organic matter content is high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 5.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIs.

540—Seelyeville muck. This nearly level, very poorly drained soil is in depressions, swales, and draws on lake plains, outwash plains, and moraines. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark grayish brown muck about 4 inches thick. The underlying material to a depth of about 60 inches is black muck. In some areas the surface layer is calcareous and has common shell fragments.

Included with this soil in mapping are small areas of Haug and Urness soils. These soils are very poorly drained and are in landscape positions similar to those of the Seelyeville soil. They make up about 15 percent of the unit.

Permeability is moderately rapid to moderately slow in the Seelyeville soil. Available water capacity is very high. Organic matter content also is very high. Surface runoff is very slow or ponded. The seasonal high water table is 2 feet above to 2 feet below the surface.

Much of the acreage is idle land that supports sedges, grasses, and lowland brush. Because of the ponding and the wetness, this soil is generally unsuitable as cropland. It is suited to wetland wildlife habitat and to limited grazing.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the extreme wetness and the flooding. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is VIw.

547—Deerwood muck. This very poorly drained, nearly level soil is in depressions, swales, and draws on lake plains. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 3 to about 110 acres in size.

Typically, the surface layer is black muck about 12 inches thick. The subsurface layer is black loamy fine sand about 4 inches thick. The underlying material to a depth of about 60 inches is mottled sand. It is olive gray in the upper part, grayish brown in the next part, and grayish brown and light brownish gray in the lower part. In a few places stones are on the surface. In some areas the content of coarse fragments in the subsurface layer and underlying material is as much as 35 percent. In other areas the surface layer is more than 16 inches thick.

Included with this soil in mapping are small areas of Arveson, Haug, and Vallers soils. Arveson soils are poorly drained and very poorly drained and are in the higher swales and draws. Haug soils are very poorly drained and are in landscape positions similar to those of the Deerwood soil. Vallers soils are poorly drained and are on the rims of the depressions. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Deerwood soil and rapid in the lower part. Available water capacity is very high in the upper part of the soil and low in the lower part. Organic matter content is very high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Much of the acreage is idle land that supports sedges, cattails, and lowland brush. Because of the flooding and the wetness, this soil is generally unsuitable as cropland.

It is suited to wetland wildlife habitat and to limited grazing.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the extreme wetness and the flooding. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is VIw.

582—Roliss clay loam. This nearly level, poorly drained soil is on flats and in slightly concave areas on lake plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is black, calcareous clay loam about 10 inches thick. The subsoil is olive gray, mottled, calcareous clay loam about 7 inches thick. The underlying material to a depth of about 60 inches is gray and olive gray, mottled, calcareous clay loam. In some areas the soil has a higher content of clay. In other areas thin layers of gravel are in the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained and moderately well drained Grimstad, Hamerly, and Kittson soils. These soils are on rises. They make up about 15 percent of the unit.

Permeability is moderate or moderately slow in the Roliss soil. Available water capacity is high. Organic matter content also is high. Surface runoff is very slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

640—Galchutt silt loam. This nearly level, somewhat poorly drained soil is on flats and slightly concave slopes on lake plains. Individual areas are irregular in shape and range from 10 to 110 acres in size.

Typically, the surface layer is black silt loam about 10 inches thick. The subsurface layer is very dark grayish brown, mottled loam about 3 inches thick. The subsoil is mottled clay about 23 inches thick. It is dark grayish brown in the upper part and olive brown and calcareous in the lower part. The underlying material to a depth of about 60 inches is olive brown, mottled, calcareous silty clay. In some areas the content of clay is lower in the surface soil or in the underlying material. In other areas the soil is subject to rare flooding.

Included with this soil in mapping are areas of Doran, Enloe, Fargo, and Lindaas soils. Doran soils are somewhat poorly drained and are in landscape positions similar to those of the Galchutt soil. Enloe, Fargo, and Lindaas soils are poorly drained. Enloe and Fargo soils are in the lower swales. Lindaas soils are in depressions. Included soils make up about 15 percent of the unit.

Permeability is moderate in the upper part of the Galchutt soil and slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is very slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

642—Clearwater sandy clay loam. This nearly level, poorly drained soil is on plane or slightly concave slopes on lake plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black sandy clay loam about 9 inches thick. The subsoil is very dark grayish brown, mottled clay about 8 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous clay and silty clay. In some places the surface layer is loam. In other places the content of clay is lower in the part of the underlying material below a depth of 28 inches. In some areas the upper part of the soil is calcareous. In other areas layers of sand and gravel more than 6 inches thick are between depths of 10 and 40 inches.

Included with this soil in mapping are small areas of Doran, Fargo, Hamerly, and Viking soils. Doran soils are somewhat poorly drained and are on convex slopes. Fargo and Viking soils are poorly drained and are in landscape positions similar to those of the Clearwater soil. Hamerly soils are somewhat poorly drained and moderately well drained and are on gentle rises. Included soils make up about 15 percent of the unit.

Permeability is slow in the Clearwater soil. Available water capacity is moderate. Organic matter content also is moderate. Surface runoff is slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

645—Espelie fine sandy loam. This nearly level, poorly drained soil is on plane or slightly concave slopes on lake plains. It is subject to rare flooding. Individual areas are irregular in shape or are long and narrow. They range from 5 to 180 acres in size.

Typically, the surface layer is black fine sandy loam about 11 inches thick. The subsoil is dark grayish brown, mottled loamy fine sand about 5 inches thick. The upper part of the underlying material is grayish brown, mottled fine sand. The lower part to a depth of about 60 inches is gray, mottled, calcareous silty clay. In some areas the upper part of the soil is calcareous. In other areas it contains gravel. In a few areas the sandy material extends to a depth of more than 40 or less than 20 inches.

Included with this soil in mapping are small areas of the moderately well drained Flaming and Hilaire soils. These soils are in the slightly higher areas or on convex slopes. They make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Espelie soil and slow in the lower part. Available water capacity is moderate. Organic matter content also is moderate. Surface runoff is slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that can withstand wetness. Seedling mortality is moderate because of the wetness. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

647—Hilaire loamy fine sand. This nearly level, moderately well drained soil is on slightly convex slopes on lake plains. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is black loamy fine sand about 10 inches thick. The subsoil is brown, mottled loamy sand about 6 inches thick. The upper part of the underlying material is pale brown, mottled loamy sand. The lower part to a depth of about 60 inches is olive gray, mottled, calcareous silty clay. In some areas the upper part of the soil is calcareous. In other areas it contains gravel. In places the sandy material extends to a depth of less than 20 inches. Some areas are subject to rare flooding.

Included with this soil in mapping are areas of Donaldson, Doran, Espelie, and Flaming soils. Donaldson soils are somewhat poorly drained and moderately well drained, and Doran soils are somewhat poorly drained. Both of these soils are on the lower, convex slopes. Espelie soils are poorly drained and are in the lower, concave areas. Flaming soils are moderately well drained and are in landscape positions similar to those of the Hilaire soil. Included soils make up about 15 percent of the unit.

Permeability is rapid in the upper part of the Hilaire soil and slow in the lower part. Available water capacity is moderate. Organic matter content is moderately low. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is fairly well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIs.

698—Doran clay loam. This nearly level, somewhat poorly drained soil is on lake plains and water-modified till plains. It is typically on plane or slightly convex slopes. Individual areas are irregular in shape and range from 10 to more than 500 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsoil is about 27 inches thick. It is very dark grayish brown clay in the upper part; dark grayish brown, mottled clay in the next part; and olive gray, mottled, calcareous clay loam in the lower part. The underlying material to a depth of about 60 inches is olive, mottled, calcareous clay loam. In a few areas the soil has a lower content of clay. In some areas coarse fragments are on the surface (fig. 5). In other areas the content of silt is higher in the underlying material. In some places the soil has a surface layer of loam and a thin, gray subsurface layer. In other places it is subject to rare flooding.

Included with this soil in mapping are small areas of Fargo, Hamerly, Lindaas, and Perella soils. Fargo and Lindaas soils are poorly drained. Fargo soils are in swales, and Lindaas soils are in depressions and swales. Hamerly soils are somewhat poorly drained and moderately well drained and are on the higher, convex slopes. Perella soils are somewhat poorly drained and are in landscape positions similar to those of the Doran soil. Included soils make up about 15 percent of the unit.

Permeability is slow in the Doran soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 3 to 5 feet.

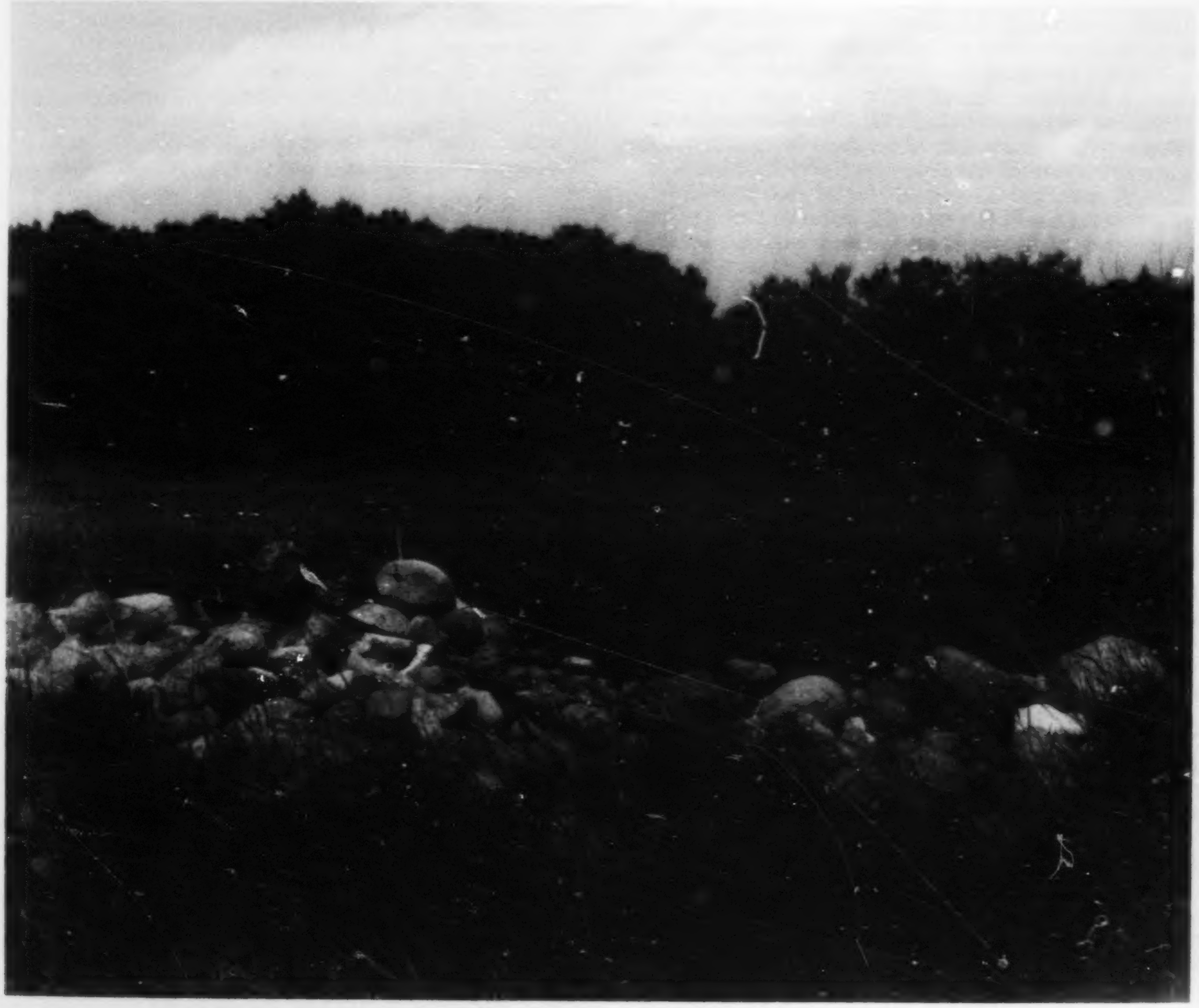


Figure 5.—A stone pile in an area of Doran clay loam. The stones have been removed from nearby fields.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

814—Hamerly-Lindaas silty clay loams. These nearly level soils are on uplands and lake plains. The somewhat poorly drained Hamerly soil is on gentle rises. The poorly drained Lindaas soil is on flats and in shallow swales. It is subject to ponding and to rare flooding. The difference in elevation between the rises and the flats or swales is typically less than 12 inches. Individual areas are irregular in shape and range from 15 to 900 acres in size. They are about 55 percent Hamerly soil and 30 percent Lindaas soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Hamerly soil has a surface layer of very dark gray, calcareous silty clay loam about 10 inches thick. The subsoil is light olive brown, calcareous clay loam about 7 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled, calcareous clay loam. Pockets of gypsum crystals and shale fragments are very common in this soil. In some areas the surface layer is mixed with the subsoil and is lighter colored. In a few areas it is noncalcareous. In places the soil has more clay and less silt.

Typically, the Lindaas soil has a surface layer of black silty clay loam about 9 inches thick. The subsoil is about 18 inches thick. It is very dark grayish brown clay in the upper part and dark grayish brown silty clay in the lower part. The underlying material to a depth of about 60 inches is grayish brown, mottled silty clay loam. In most areas the soil has a few coarse fragments.

Included with these soils in mapping are areas of Doran, Enloe, and Fargo soils. Doran soils are somewhat poorly drained and are in landscape positions similar to those of the Hamerly soil. Enloe and Fargo soils are poorly drained and are in landscape positions similar to those of the Lindaas soil. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Hamerly soil and slow in the Lindaas soil. Available water capacity and organic matter content are high in both soils. Surface runoff is slow on the Hamerly soil and very slow or ponded on the Lindaas soil. The seasonal high water table is at a depth of 2 to 4 feet in the Hamerly soil and is 1 foot above to 2 feet below the surface of the Lindaas soil.

Most areas are cropped. These soils are well suited to cropland and pasture. The wetness of the Lindaas soil and soil blowing on the Hamerly soil are the principal limitations. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the high content of lime in the Hamerly soil and the wetness of the Lindaas soil. Because of the wetness, seedling mortality is severe and spring planting may be delayed. The free carbonates in the Hamerly soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

821—Doran-Lindaas complex. These nearly level soils are on till plains and lake plains. The somewhat poorly drained Doran soil is on gentle rises and flats. The poorly drained Lindaas soil is in shallow swales and depressions. It is subject to ponding and to rare flooding. The difference in elevation between the rises and the swales or depressions is typically less than 12 inches. Individual areas are irregular in shape and range from 50 to 800 acres in size. They are about 55 percent Doran soil and 35 percent Lindaas soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Doran soil has a surface layer of black clay loam about 9 inches thick. The subsoil is dark grayish brown silty clay about 10 inches thick. It is calcareous in the lower part. The underlying material to a depth of about 60 inches is dark grayish brown, mottled, calcareous silty clay loam.

Typically, the Lindaas soil has a surface layer of black silt loam about 12 inches thick. The subsurface layer is very dark gray silt loam about 5 inches thick. The subsoil is very dark gray clay about 18 inches thick. It is mottled in the lower part. The underlying material to a depth of about 60 inches is grayish brown, mottled, calcareous silty clay loam.

Included with these soils in mapping are small areas of the moderately well drained Aazdahl and somewhat poorly drained and moderately well drained Hamerly soils on the higher rises and flats. These soils make up about 10 percent of the unit.

Permeability is slow in the Doran and Lindaas soils. Available water capacity and organic matter content are high. Surface runoff is slow on the Doran soil and very slow or ponded on the Lindaas soil. The seasonal high water table is at a depth of 3 to 5 feet in the Doran soil and is 1 foot above to 2 feet below the surface of the Lindaas soil.

Most areas are cropped. These soils are well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Doran soil. The trees and shrubs grown on the Lindaas soil should be those that are tolerant of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

903B2—Barnes-Langhei loams, 2 to 6 percent slopes, eroded. These nearly level and gently undulating, well drained soils are on till plains and moraines. The Barnes soil is on side slopes and the slightly lower knobs and ridges, and the Langhei soil is on the tops of knobs and on breaks on the upper parts of the slopes. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 200 acres in size. They are about 55 percent Barnes soil and 30 percent Langhei soil. The two soils occur as areas so intricately mixed that separating in mapping was not practical.

Typically, the Barnes soil has a surface layer of very dark grayish brown loam about 10 inches thick. The subsoil is dark grayish brown loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive brown, calcareous loam. In places the soil is clay loam throughout.

Typically, the Langhei soil has a surface layer of dark grayish brown, calcareous loam about 8 inches thick. The underlying material to a depth of about 60 inches is light olive brown, calcareous loam. In places the soil is clay loam throughout.

Included with these soils in mapping are small areas of Darnen, Kittson, Rothsay, and Zell soils. Darnen soils are moderately well drained and are at the base of the steeper slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in the lower landscape positions. Rothsay and Zell soils are well drained. Rothsay soils are in landscape positions similar to those of the Barnes soil, and Zell soils are in positions similar to those of the Langhei soil. Also included are small areas of somewhat excessively drained soils that are underlain by sand. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Barnes and Langhei soils. Available water capacity is high in the Barnes soil and moderate in the Langhei soil. Organic matter content is moderate in the Barnes soil and low or moderately low in the Langhei soil. Surface runoff is medium on both soils.

Most areas are cropped. This soil is well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Barnes soil. The trees and shrubs grown on the Langhei soil should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification of the Barnes soil is IIe, and that of the Langhei soil is IIIe.

908—Bearden-Fargo complex. These nearly level soils are on lake plains. The somewhat poorly drained Bearden soil is on gentle rises. The poorly drained Fargo soil is in shallow drainageways and swales. It is subject to rare flooding. The difference in elevation between the rises and the swales is typically less than 8 inches. The rises and swales are typically oriented in a northwest-southeast direction. Individual areas are irregular in shape and range from 40 to 320 acres in size. They are about 55 percent Bearden soil and 30 percent Fargo soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Bearden soil has a surface layer of calcareous silty clay loam about 13 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is dark grayish brown and grayish brown, calcareous silty clay loam about 9 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled, calcareous silty clay loam. Some areas are subject to rare flooding.

Typically, the Fargo soil has a surface layer of black silty clay about 12 inches thick. The subsoil is about 9 inches of dark olive gray silty clay and clay. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous silty clay.

Included with these soils in mapping are areas of Colvin, Perella, and Wahpeton soils. Colvin soils are poorly drained and are in swales. Perella and Wahpeton soils are in landscape positions similar to those of the Bearden soil. Perella soils are somewhat poorly drained, and Wahpeton soils are moderately well drained. Included soils make up about 15 percent of the unit.

Permeability is moderately slow in the Bearden soil and slow in the Fargo soil. Available water capacity is high in the Bearden soil and moderate in the Fargo soil.

Organic matter content is high in both soils. Surface runoff is slow on the Bearden soil and very slow on the Fargo soil. The seasonal high water table is at a depth of 2 to 4 feet in the Bearden soil and is within a depth of 3 feet in the Fargo soil.

Most areas are cropped. These soils are well suited to cropland and pasture. The wetness of the Fargo soil is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the high content of lime in the Bearden soil and the wetness of the Fargo soil. Because of the wetness, seedling mortality is severe and spring planting may be delayed. The free carbonates in the Bearden soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

942C2—Langhei-Barnes loams, 6 to 12 percent slopes, eroded. These rolling, well drained soils are on moraines and uplands. The Langhei soil is on knobs and on breaks on the upper parts of the slopes. The Barnes soil is on side slopes. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 150 acres in size. They are about 55 percent Langhei soil and 30 percent Barnes soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Langhei soil has a surface layer of dark grayish brown, calcareous loam about 6 inches thick. The next layer is light olive brown, calcareous loam about 16 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, calcareous loam. In places the content of sand is higher in the surface layer.

Typically, the Barnes soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is about 11 inches thick. It is dark brown loam in the upper part and dark yellowish brown clay loam in the lower part. The underlying material to a depth of about 60 inches is light yellowish brown, calcareous loam. In places the content of sand is higher in the surface layer.

Included with these soils in mapping are small areas of Darnen, Kittson, and Rothsay soils. Darnen soils are moderately well drained and are at the base of the steeper slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in the lower landscape positions. Rothsay soils are well drained and are in positions similar to those of the Langhei soil. Also included are small areas of somewhat excessively drained soils that are underlain by sandy material. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Langhei and Barnes soils. Available water capacity is moderate in the Langhei soil and high in the Barnes soil. Organic matter content is low or moderately low in the Langhei soil and moderate in the Barnes soil. Surface runoff is rapid on both soils.

Most areas are cropped. These soils are fairly well suited to cropland. If the soils are cropped, further erosion is a serious hazard. The slope limits some kinds of fieldwork. If row crops are planted up and down the slope, runoff commonly is channeled and the hazard of erosion is increased. Measures that maintain or improve fertility and tilth are needed, especially in areas of the Langhei soil, which is low in natural fertility. Crop residue management, minimum tillage, and, where feasible, contour farming help to control erosion. In areas of concentrated waterflow, grassed waterways help to keep rills and gullies from forming. Applications of commercial fertilizer help to ensure that the supply of plant nutrients is adequate. Returning crop residue to the soil, plowing green manure crops under, and adding barnyard manure help to maintain the organic matter content and soil structure.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the high content of lime, particularly in the Langhei soil. The free carbonates in the Langhei soil tie up plant nutrients and limit their availability. The slope limits the effectiveness of the windbreaks. Water erosion is a severe hazard unless site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification of the Langhei soil is IVe, and that of the Barnes soil is IIIe.

942D2—Langhei-Barnes loams, 12 to 18 percent slopes, eroded. These hilly, well drained soils are on moraines and uplands. The Langhei soil is on knobs and on breaks on the upper parts of the slopes. The Barnes soil is on side slopes. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 75 acres in size. They are about 60 percent Langhei soil and 25 percent Barnes soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Langhei soil has a surface layer of dark grayish brown, calcareous loam about 7 inches thick. The underlying material to a depth of about 60 inches is light olive brown, calcareous loam. In some areas the surface layer is sandy loam.

Typically, the Barnes soil has a surface layer of very dark gray loam about 10 inches thick. The subsoil is dark brown and brown loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive brown, calcareous loam. In some areas the surface layer is sandy loam.

Included with these soils in mapping are small areas of Darnen, Kittson, and Rothsay soils. Darnen soils are moderately well drained and are at the base of the steeper slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in the lower landscape positions. Rothsay soils are well drained and are in positions similar to those of the Barnes soil. Also included are small areas of somewhat excessively drained soils that are underlain by sand. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Langhei and Barnes soils. Available water capacity is moderate in the Langhei soils and high in the Barnes soil. Organic matter content is low or moderately low in the Langhei soil and moderate in the Barnes soil. Surface runoff is very rapid on the Langhei soil and rapid on the Barnes soil.

Many areas are cropped. Some are pastured. These soils are poorly suited to cropland. If the soils are cropped, further erosion is a serious hazard. The slope limits some kinds of fieldwork. If row crops are planted up and down the slope, runoff is channeled and the hazard of erosion is increased. Measures that maintain or improve fertility and tilth are needed, especially in areas of the Langhei soil, which is low in natural fertility. Crop residue management, minimum tillage, and, where feasible, contour farming help to control erosion. In areas of concentrated waterflow, grassed waterways help to keep rills and gullies from forming. Applications of commercial fertilizer help to ensure that the supply of plant nutrients is adequate. Returning crop residue to the soil, plowing green manure crops under, and adding barnyard manure help to maintain the organic matter content and soil structure.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the high content of lime, particularly in the Langhei soil. The free carbonates in the Langhei soil tie up plant nutrients and limit their availability. The slope limits the effectiveness of the windbreaks. Water erosion is a severe hazard unless site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification of the Langhei soil is VIe, and that of the Barnes soil is IVe.

957B2—Rothsay-Zell silt loams, 2 to 6 percent slopes, eroded. These gently undulating, well drained soils are on lake plains, moraines, and uplands. The Rothsay soil is on side slopes and the slightly lower knobs and ridges. The Zell soil is on the tops of knobs and on breaks on the upper parts of the slopes. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 200 acres in size. They are about 50 percent Rothsay soil and 35 percent Zell soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Rothsay soil has a surface layer of very dark grayish brown silt loam about 10 inches thick. The subsoil is dark brown silt loam about 5 inches thick. The upper part of the underlying material is pale brown and yellowish brown, calcareous silt loam. The lower part to a depth of about 60 inches is light yellowish brown, calcareous very fine sandy loam. In places the surface layer is very fine sandy loam.

Typically, the Zell soil has a surface layer of dark grayish brown, calcareous silt loam about 8 inches thick. The subsoil is olive yellow, calcareous silt loam about 20 inches thick. The underlying material to a depth of about 60 inches is pale brown, mottled, calcareous very fine sandy loam. In places the surface layer is very fine sandy loam.

Included with these soils in mapping are small areas of Barnes and Hantho soils. Barnes soils are well drained and are in landscape positions similar to those of the Rothsay soil. Hantho soils are moderately well drained and are on the lower side slopes. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Rothsay and Zell soils. Available water capacity is high. Organic matter content is high in the Rothsay soil and moderate in the Zell soil. Surface runoff is medium on both soils.

Most areas are cropped. These soils are well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the Rothsay soil. The trees and shrubs grown on the Zell soil should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification of the Rothsay soil is IIe, and that of the Zell soil is IIIe.

969B—Zell-Rothsay silt loams, 1 to 4 percent slopes. These nearly level and gently undulating, well drained soils are on lake plains, moraines, and uplands. The Zell soil is on the tops of rises and on breaks on the upper parts of the slopes. The Rothsay soil is on side slopes and the slightly lower rises. Individual areas are irregular in shape and range from 10 to 150 acres in size. They are about 55 percent Zell soil and 30 percent Rothsay soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Zell soil has a surface layer of very dark gray, calcareous silt loam about 7 inches thick. The subsurface layer is dark grayish brown, calcareous silt loam about 5 inches thick. The subsoil is light olive brown, calcareous silt loam about 7 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown and calcareous. It is silt loam in the upper part and very fine sandy loam in the lower part. In some areas the surface layer is noncalcareous. In other areas moderate erosion has removed part of the topsoil.

Typically, the Rothsay soil has a surface layer of black silt loam about 11 inches thick. The subsoil is dark brown silt loam about 5 inches thick. The upper part of the underlying material is pale brown, calcareous silt loam. The lower part to a depth of about 60 inches is light yellowish brown, mottled, calcareous very fine sandy loam.

Included with these soils in mapping are small areas of Hantho and Glyndon soils. Hantho soils are moderately well drained and are on the lower side slopes. Glyndon soils are somewhat poorly drained and moderately well drained and are in swales. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Zell and Rothsay soils. Available water capacity is high. Organic matter content is moderate in the Zell soil and high in the Rothsay soil. Surface runoff is medium on both soils.

Most areas are cropped. These soils are well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings on the Zell soil should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. A wide variety of trees and shrubs can be grown on the Rothsay soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification of the Zell soil is IIIe, and that of the Rothsay soil is IIe.

969C2—Zell-Rothsay silt loams, 6 to 12 percent slopes, eroded. These rolling, well drained soils are on lake plains, moraines, and uplands. The Zell soil is on the tops of knobs and on breaks on the upper parts of the slopes, and the Rothsay soil is on side slopes and the slightly lower knobs and ridges. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 200 acres in size. They are about 55 percent Zell soil and 35 percent Rothsay soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Zell soil has a surface layer of dark gray, calcareous silt loam about 7 inches thick. The subsoil is pale brown, calcareous silt loam about 9 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In some areas the subsoil is mixed with the surface layer.

Typically, the Rothsay soil has a surface layer of very dark gray silt loam about 8 inches thick. The subsoil is dark brown silt loam about 8 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In a few places the surface layer has a higher content of fine sand.

Included with these soils in mapping are small areas of Barnes and Hantho soils. Barnes soils are well drained and are in landscape positions similar to those of the Rothsay soil. Hantho soils are moderately well drained and are in swales. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Zell and Rothsay soils. Available water capacity is high. Organic matter content is moderate in the Zell soil and high in the Rothsay soil. Surface runoff is rapid on the Zell soil and medium on the Rothsay soil.

Most areas are cropped. These soils are fairly well suited to cropland. If the soils are cropped, further erosion is a serious hazard. The slope limits some kinds of fieldwork. If row crops are planted up and down the slope, runoff commonly is channeled and the hazard of erosion is increased. Measures that maintain or improve fertility and tilth are needed, especially in areas of the Zell soil, which is low in natural fertility. Crop residue management, minimum tillage, and, where feasible, contour farming help to control erosion. In areas of concentrated waterflow, grassed waterways help to keep rills and gullies from forming. Applications of commercial fertilizer help to ensure that the supply of plant nutrients is adequate. Returning crop residue to the soil, plowing green manure crops under, and adding barnyard manure help to maintain the organic matter content and soil structure.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the high content of lime, particularly in the Zell soil. The free carbonates in this soil tie up plant nutrients and limit their availability. The slope limits the effectiveness of the windbreaks. Water erosion is a severe hazard unless site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification of the Zell soil is IVe, and that of the Rothsay soil is IIIe.

969D2—Zell-Rothsay silt loams, 12 to 18 percent slopes, eroded. These hilly, well drained soils are on uplands, lake plains, and moraines. The Zell soil is on the tops of knobs and on breaks on the upper parts of the slopes. The Rothsay soil is on side slopes and the slightly lower knobs and ridges. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 50 acres in size. They are about 60 percent Zell soil and 30 percent Rothsay soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Zell soil has a surface layer of dark grayish brown, calcareous silt loam about 6 inches thick. The subsoil is light yellowish brown, calcareous silt loam about 12 inches thick. The upper part of the underlying material is yellowish brown, calcareous very fine sandy loam. The lower part to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In some areas the subsoil is mixed with the surface layer.

Typically, the Rothsay soil has a surface layer of very dark gray silt loam about 8 inches thick. The subsoil is dark brown silt loam about 7 inches thick. The underlying material to a depth of about 60 inches is brown and pale brown, calcareous very fine sandy loam. In places the surface layer has a higher content of fine sand.

Included with these soils in mapping are small areas of Barnes and Hantho soils. Barnes soils are well drained and are in landscape positions similar to those of the Rothsay soil. Hantho soils are moderately well drained and are on the lower side slopes. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Zell and Rothsay soils. Available water capacity is high. Organic matter content is moderate in the Zell soil and high in the Rothsay soil. Surface runoff is rapid on the Zell soil and medium on the Rothsay soil.

Most areas are cropped. These soils are poorly suited to cropland. If the soils are cropped, further erosion is a serious hazard. The slope limits some kinds of fieldwork. If row crops are planted up and down the slope, runoff commonly is channeled and the hazard of erosion is increased. Measures that maintain or improve fertility and tilth are needed, especially in areas of the Zell soil, which is low in natural fertility. Crop residue management, minimum tillage, and, where feasible, contour farming help to control erosion. In areas of concentrated waterflow, grassed waterways help to keep rills and gullies from forming. Applications of commercial fertilizer help to ensure that the supply of plant nutrients is adequate. Returning crop residue to the soil, plowing green manure crops under, and adding barnyard manure help to maintain the organic matter content and soil structure.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of the high content of lime, particularly in the Zell soil. The free carbonates in this soil tie up plant nutrients and limit their availability. The slope limits the effectiveness of the windbreaks. Water erosion is a severe hazard unless site preparation is limited to the area within 2 feet of where the plant is to be established. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification of the Zell soil is VIe, and that of the Rothsay soil is IVe.

987—Rockwell fine sandy loam, depressional. This nearly level, very poorly drained soil is in depressions, swales, and draws on lake plains. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 3 to 25 acres in size.

Typically, the surface layer is black, calcareous fine sandy loam about 12 inches thick. The subsoil is olive gray, calcareous sandy loam about 7 inches thick. The underlying material to a depth of about 60 inches is mottled. It is light olive gray loamy sand and fine sand in the upper part and gray loam in the lower part. In some areas, the surface layer is more than 12 inches thick and the soil has dark buried layers. In other areas the upper part of the surface layer is highly decomposed organic material.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Arveson and very poorly drained Parnell soils. These soils are in landscape positions similar to those of the Rockwell soil. They make up about 15 percent of the unit.

Permeability is moderate in the Rockwell soil. Available water capacity is moderate or high. Organic matter content is high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

Most areas are used as hayland or pasture. This soil is fairly well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. The free carbonates in this soil tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIw.

1029—Pits, gravel. This map unit consists of pits from which gravelly material has been excavated. These pits are generally in areas of Sioux and Lohnes soils on beach ridges and gravelly outwash plains (fig. 6). The surface layer has been stripped from these soils and deposited around the edges of the gravel pits. The coarser gravelly material has been removed. The size and shape of the pits are determined by the quantity and quality of gravel at each site. Many pits have been abandoned because the supply of suitable gravel has been exhausted. Some of the deeper abandoned pits are filled with water. In many of the larger pits, gravel and sand are removed from water by drag lines.

Included in this map unit are a few areas where soil material that ranges from sand to clay has been removed. This material is used mainly for roads and railroad grades.

Introduced and native grasses and a few trees grow in and around the abandoned pits. The grasses provide limited grazing for livestock. The deeper ponded pits are used as a water supply. Many abandoned pits provide cover and water for wildlife. Some are being reclaimed through the replacement of topsoil and through reseeding.

This map unit is not assigned to a land capability classification.

1055—Haplaquolls and Histosols, ponded. These level, very poorly drained soils are in swales, in depressions, and in a few areas adjacent to streams and lakes. They are typically covered with water throughout most of the year (fig. 7). Individual areas are irregular in shape and range from 3 to 120 acres in size. Some are made up of only Haplaquolls, some are made up of only Histosols, and some are made up of both soils.

Typically, the Haplaquolls have a surface layer of black clay loam about 16 inches thick. The next layer is dark gray clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is gray, mottled loam and silt loam. In some areas strata of sandy loam and silty clay loam are in the underlying material.

Typically, the Histosols have a surface layer of black mucky peat about 24 inches thick. The next layer is very dark gray mucky peat about 18 inches thick. The underlying material to a depth of about 60 inches is olive gray clay loam. Some shell fragments are on the

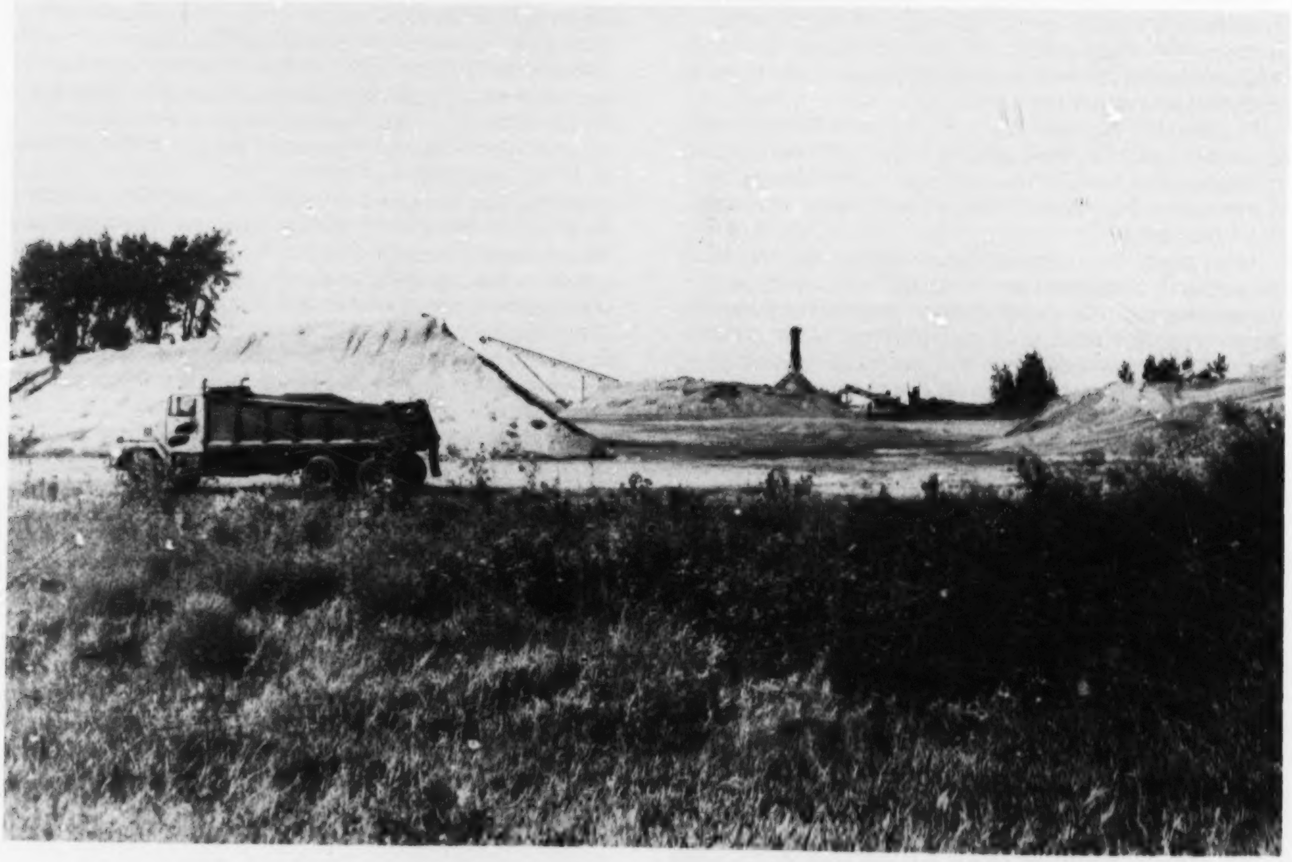


Figure 6.—A gravel pit in an area of Lohnes soils.

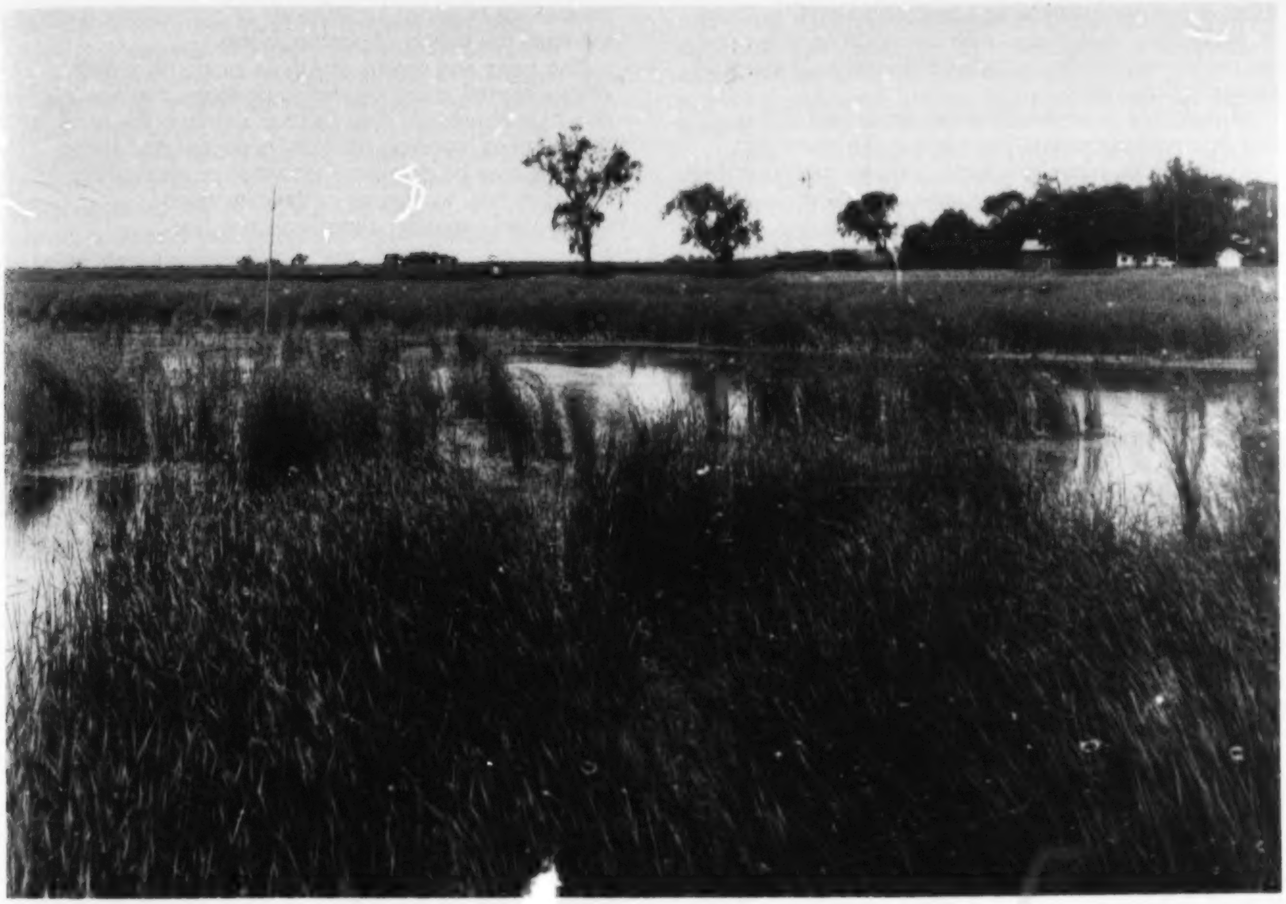


Figure 7.—An [illegible] of Haplaquolls and Histosols, ponded.

surface. In some places the underlying material is sand. In other places the surface layer is less than 16 inches thick. In some areas the soil is calcareous.

Permeability is moderately rapid to moderately slow in the Haplaquolls and Histosols. Available water capacity is high. Organic matter content is high or very high. Surface runoff is ponded. The seasonal high water table is 3 feet above to 1 foot below the surface.

Most of the acreage is idle land that supports sedges, cattails, rushes, and other water-tolerant plants. Because of the ponding, these soils are generally unsuitable as cropland. They are suited to wetland wildlife habitat.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of extreme wetness and ponding. Because of the wetness, seedling mortality is severe.

The land capability classification is VIIIw.

1819—Glyndon silty clay loam. This nearly level, somewhat poorly drained and moderately well drained soil is in lake basins. It is on flats and gentle rises. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is gray, calcareous silty clay loam about 8 inches thick. The subsoil is light yellowish brown, calcareous very fine sandy loam about 6 inches thick. The underlying material to a depth of about 60 inches is light brownish gray, mottled, calcareous very fine sandy loam and silt loam. In places the surface soil is mixed with the subsoil and is calcareous. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Aazdahl, Bearden, Fargo, and Wheatville soils. Aazdahl soils are moderately well drained and are on the higher rises. Bearden and Wheatville soils are somewhat poorly drained and are in landscape positions similar to those of the Glyndon soil. Fargo soils are poorly drained and are on the lower flats. Included soils make up about 15 percent of the unit.

Permeability is moderate in the upper part of the Glyndon soil and moderately rapid in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

1871—Fargo silty clay, swales. This nearly level, poorly drained soil is in swales on lake plains. It is subject to ponding and to rare flooding. Individual areas are typically elongated and range from 20 to 150 acres in size.

Typically, the surface soil is black silty clay about 10 inches thick. The subsoil is dark olive gray, mottled clay about 8 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled clay. In some areas the content of clay is higher in the upper part of the soil. In a few areas the soil has dark buried layers. In some places the dark surface soil is more than 24 inches thick. In other places coarse fragments are on the surface.

Included with this soil in mapping are small areas of Cashel and Colvin soils. Cashel soils are somewhat poorly drained and are in the swales. Colvin soils are poorly drained and are in landscape positions similar to those of the Fargo soil. Included soils make up about 15 percent of the unit.

Permeability is slow in the Fargo soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is ponded. The seasonal high water table is 0.5 foot above to 1.0 foot below the surface.

Most areas are cropped. This soil is fairly well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime and the wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIw.

1872—Fargo silty clay, silty substratum. This nearly level, poorly drained soil is on lake plains. It is typically on flats and gentle rises. It is subject to rare flooding. Individual areas are irregular in shape and range from 30 to 320 acres in size.

Typically, the surface soil is black silty clay about 13 inches thick. The subsoil is dark olive gray silty clay about 17 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous silty clay loam. In some areas the soil is somewhat poorly drained. In places the underlying material is loam. In a few areas the surface layer is calcareous.

Included with this soil in mapping are small areas of Colvin and Bearden soils. Colvin soils are poorly drained and are in landscape positions similar to those of the Fargo soil. Bearden soils are somewhat poorly drained and are in the slightly higher positions. Included soils make up about 15 percent of the unit.

Permeability is slow in the upper part of the Fargo soil and moderately slow or moderate in the lower part. Available water capacity is moderate or high. Organic matter content is high. Surface runoff is very slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

1874—Lohnes sandy loam. This nearly level, moderately well drained soil is on lake plains and outwash plains. It is typically on the lower side slopes and in shallow swales. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is black sandy loam about 12 inches thick. The subsoil is about 9 inches thick. It is dark grayish brown loamy sand in the upper part and dark yellowish brown sand in the lower part. The underlying material to a depth of about 60 inches is gravelly loamy sand. It is grayish brown in the upper part, light brownish gray in the next part, and light yellowish brown in the lower part. In places the surface layer is calcareous. In a few areas the underlying material is very gravelly loamy sand. In some areas loam is below a depth of 36 inches. In other areas stones and boulders are on or directly below the surface. In places the slope is more than 3 percent.

Included with this soil in mapping are small areas of Flaming and Osakis soils. These soils are moderately well drained and are in landscape positions similar to those of the Lohnes soil. They make up about 15 percent of the unit.

Permeability is rapid in the Lohnes soil. Available water capacity is low or moderate. Organic matter content is moderately low. Surface runoff is very slow. The depth to a seasonal high water table is 3 to 5 feet.

A large acreage is used as hayland or pasture. Some areas are cropped. This soil is poorly suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by the restricted available water capacity. During the early years of establishment, leaving some vegetation on the surface or mulching helps to control soil blowing and conserves moisture.

The land capability classification is IVs.

1913C—Wahpeton-Cashel silty clays, 0 to 15 percent slopes. These nearly level to moderately steep soils are on narrow slopes and breaks and on low flood plains adjacent to stream channels. The moderately well drained, occasionally flooded Wahpeton soil is on breaks on the upper parts of the landscape and on side slopes. The somewhat poorly drained, frequently flooded Cashel soil is on the lower side slopes and on flats. Individual areas are irregular in shape and range from 4 to 150 acres in size. They are about 55 percent Wahpeton soil and 45 percent Cashel soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Wahpeton soil has a surface soil of black and very dark gray silty clay about 17 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown. It is clay in the upper part and silty clay in the lower part. In some areas the soil has very dark brown and black buried layers. In other areas the content of silt is higher below a depth of 40 inches. In a few areas moderate erosion has removed part of the topsoil.

Typically, the Cashel soil has a surface soil of black silty clay about 14 inches thick. The underlying material to a depth of about 60 inches is silty clay. It is mainly dark grayish brown in the upper part and grayish brown and mottled in the lower part. A buried layer of very dark grayish brown silty clay is in the underlying material. Woody fragments and shell fragments are in the lower part of the underlying material. In places the soil has layers of silt loam and silty clay loam.

Permeability is moderate or moderately slow in the Wahpeton soil and moderately slow or slow in the Cashel soil. Available water capacity is moderate or high in both soils. Organic matter content is high. Surface runoff is slow to rapid. The Cashel soil has a seasonal high water table at a depth of 1 to 3 feet.

Most of the acreage is idle land. Because of flooding, channels, and inaccessibility, these soils are generally unsuitable as cropland. They are suited to wetland and openland wildlife habitat and to limited grazing.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of floodwater. Because of the flooding, seedling mortality is severe.

The land capability classification of the Wahpeton soil is IIIe, and that of the Cashel soil is VIw.

1916—Lindaas silt loam. This nearly level, poorly drained soil is in swales and shallow depressions on lake plains. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is mottled clay about 18 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The underlying material to a depth of about 60 inches is mottled, calcareous silty clay loam. It is olive gray in the upper part and grayish brown in the lower part. The soil commonly has coarse fragments.

Included with this soil in mapping are areas of Doran, Enloe, and Fargo soils. Doran soils are somewhat poorly drained and are on swells. Enloe and Fargo soils are poorly drained and are in landscape positions similar to those of the Lindaas soil. Included soils make up about 10 percent of the unit.

Permeability is slow in the Lindaas soil. Available water capacity is high. Organic matter content also is high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 2 feet below the surface.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas.

Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

1921—Foldahl very fine sandy loam. This nearly level, moderately well drained soil is on plane or convex slopes on lake plains. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black very fine sandy loam about 10 inches thick. The subsoil is dark grayish brown loamy fine sand about 12 inches thick. The upper part of the underlying material is light olive brown, mottled loamy fine sand. The lower part to a depth of about 60 inches is light brownish gray silty clay loam. In some areas the dark surface layer is more than 16 inches thick. In a few areas stones are on or directly below the surface. In some places a thin layer of gravel is between the upper and lower parts of the underlying material. In other places the depth to silty clay loam is more than 40 inches. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Grimstad and Swenoda soils. Grimstad soils are somewhat poorly drained and moderately well drained and are on the lower slopes. Swenoda soils are moderately well drained and are in landscape positions similar to those of the Foldahl soil. Included soils make up about 15 percent of the map unit.

Permeability is rapid in the upper part of the Foldahl soil and moderately slow or moderate in the lower part. Available water capacity is moderate or low. Organic matter content is moderate. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 4.0 feet.

Many areas are cropped. This soil is well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIs.

1944—Perella silty clay. This nearly level, somewhat poorly drained soil is in lake basins. It is typically on flats and on a few gentle rises or the slightly higher terraces. Individual areas are irregular in shape and range from 5 to 120 acres in size.

Typically, the surface layer is black silty clay about 9 inches thick. The subsoil is very dark grayish brown silty clay about 10 inches thick. The underlying material to a depth of about 60 inches is grayish brown, mottled, calcareous silt loam and silty clay loam. In places coarse fragments are on the surface. In a few areas the surface layer is calcareous.

Included with this soil in mapping are small areas of Clearwater, Doran, Fargo, and Wahpeton soils. Clearwater and Fargo soils are poorly drained and are in the lower landscape positions. Doran soils are somewhat poorly drained and are in positions similar to those of the Perella soil. Wahpeton soils are moderately well drained and are on the slightly higher rises and flats. Included soils make up about 15 percent of the unit.

Permeability is slow or moderately slow in the Perella soil. Available water capacity is high. Organic matter content also is high. Surface runoff is very slow. The depth to a seasonal high water table is 2 to 4 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is moderate. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

1948—Fargo-Enloe complex. These nearly level, poorly drained soils are on lake plains. They are subject to rare flooding. The Fargo soil is on gentle rises, and the Enloe soil is in shallow swales. The difference in elevation between the swales and the rises is typically less than 8 inches. Land leveling has reduced elevation differences in many fields. Individual areas are irregular in shape and range from 40 to 640 acres in size. They are about 50 percent Fargo soil and 35 percent Enloe soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Fargo soil has a surface layer of black silty clay about 10 inches thick. The subsoil is olive gray clay about 12 inches thick. The underlying material to a depth of about 60 inches is olive gray, calcareous clay. In places the surface layer is calcareous.

Typically, the Enloe soil has a surface layer of black silty clay loam about 9 inches thick. The subsurface layer is very dark gray silty clay loam about 5 inches thick. The subsoil is black and very dark gray clay about 12 inches thick. The underlying material to a depth of about 60 inches is olive gray and dark gray, calcareous clay. In a few places the content of clay is lower in the underlying material.

Included with these soils in mapping are small areas of Doran and Lindaas soils. Doran soils are somewhat poorly drained and are on the higher rises. Lindaas soils are poorly drained and are in swales. Included soils make up about 15 percent of the unit.

Permeability is slow in the Fargo and Enloe soils. Available water capacity is moderate. Organic matter content is high. Surface runoff is very slow on the Fargo soil and ponded on the Enloe soil. The seasonal high water table is within a depth of 3 feet in the Fargo soil and is 1 foot above to 1 foot below the surface of the Enloe soil.

Most areas are cropped. These soils are well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

1971—Divide loam. This nearly level, somewhat poorly drained and moderately well drained soil is in slightly convex areas on outwash plains. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is black, calcareous loam about 9 inches thick. The subsurface is very dark gray, calcareous loam about 6 inches thick. The subsoil is dark gray, calcareous loam about 8 inches thick. The upper part of the underlying material is olive, calcareous very gravelly loamy sand. The lower part to a depth of about 60 inches is olive brown, mottled, calcareous, stratified gravelly sand and fine sand. In places the underlying material is loam below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained and moderately well drained Hamerly and moderately well drained Osakis soils. These soils are in landscape positions similar to those of the Divide soil. They make up about 15 percent of the unit.

Permeability is moderate in the upper part of the Divide soil and rapid or very rapid in the lower part. Available water capacity is moderate. Organic matter content is moderate or high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 5.0 feet.

Many areas are cropped. This soil is fairly well suited to cropland. Soil blowing is the main hazard, and droughtiness is the main limitation, especially when precipitation is less than normal or poorly distributed. Improving or maintaining fertility also is a management concern. Crop residue management, minimum tillage, cover crops, and field windbreaks help to control soil blowing and increase the moisture supply. Additions of barnyard manure increase the level of fertility. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime. The free carbonates in this soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIs.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 437,000 acres in the survey area, or nearly 91 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county. The crops grown on this land, namely wheat, barley, sugar beets, corn, and soybeans, account for most of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Wilkin County has approximately 301,300 acres of cropland. In 1984, about 119,800 acres of this land was used for corn, soybeans, and other row crops, including dry beans, sunflowers, and sugar beets; 168,000 acres was used for small grain, including wheat, barley, and oats; and 13,500 acres was used for hay and pasture *(8)*.

The paragraphs that follow describe the main concerns in managing the soils in the county for crops and pasture.

Soil blowing is a hazard on about three-fourths of the cropland in the county. The factors that influence the susceptibility to soil blowing are the texture of the surface layer, free carbonates at the surface, surface roughness, field size, and vegetative cover. Ulen, Flaming, Glyndon, Grimstad, Foldahl, Donaldson, Wyndmere, Lohnes, and Elmville are the most susceptible soils. These soils either have a sandy surface layer or have free carbonates at the surface. The carbonates adversely affect the stability of soil aggregates and thus increase the hazard of soil blowing.

Soil blowing can be controlled by measures that create a rough surface, reduce the size of fields, or establish a protective plant cover. A rough surface can be created by some types of tillage. Leaving moldboard-plowed fields rough and cloddy in the fall can reduce the hazard of erosion until these conditions are destroyed by freezing or thawing. Using a chisel plow instead of a moldboard plow results in a more stable, better defined pattern of ridges and valleys and incorporates crop residue into the soil or leaves it on the surface.

Wide fields allow soil blowing to reach maximum levels. Establishing field windbreaks or other vegetative barriers and wind stripcropping reduce the width of the fields and thus help to control soil blowing. The Soil Conservation Service and the Wilkin County Soil and Water Conservation District can assist in selecting suitable species, in selecting proper sites for vegetative barriers, and in wind stripcropping.

Managing crop residue can be one of the most cost effective methods of controlling soil blowing. Tillage methods that leave part or all of the crop residue on the surface are very effective in controlling soil blowing. The residue can be managed by using a chisel plow, disk, or field cultivator. The primary tillage can incorporate some of the residue into the soil. This measure leaves the surface rough and leaves some exposed soil to warm up and dry out in the spring, thus permitting timely secondary tillage and planting.

Conservation tillage is a form of crop residue management in which at least 30 percent of the surface is covered with residue after planting. Forms of conservation tillage include mulch-till, strip-till, and no-till. The factors that should be considered when a system of conservation tillage is selected include soil texture, drainage, slope, and the crops to be grown. Tillage methods that leave a small amount of crop residue on the surface and a ridge-till system of row cropping are effective on the more poorly drained soils. Tillage methods that leave a large amount of crop residue on the surface, including strip-till and no-till, are most effective on moderately well drained to excessively drained soils.

Conservation tillage not only helps to control erosion but also can save time, reduce fuel consumption, lower equipment costs, conserve moisture, and improve wildlife habitat. The Soil Conservation Service and the Cooperative Extension Service can assist in selecting suitable systems of conservation tillage for specific tracts.

Water erosion is a problem on approximately one-third of the cropland in the county. It is a hazard on the gently sloping to moderately steep Rothsay, Zell, Barnes, and Langhei soils. Contour farming, terraces, diversions, and a cropping sequence that includes grasses and legumes are effective in controlling sheet and rill erosion. Applying these measures is difficult in the northeastern part of the county, however, because of short, irregular slopes. On these slopes, a system of conservation tillage can help to control sheet and rill erosion and grassed waterways or water- and sediment-control basins can help to control the erosion caused by concentrated waterflow.

Even the nearly level soils on the lake plain of glacial Lake Agassiz are subject to the erosion caused by concentrated waterflow. This erosion occurs in areas where field drainage systems enter county road ditches and in areas near drainage outlets. Erosion-control structures and surface water inlets are needed in these areas.

Soil blowing and water erosion reduce the productivity of soils by removing plant nutrients and organic matter from the surface layer. As the thickness of the topsoil is reduced by erosion, part of the less fertile subsoil is incorporated into the plow layer. Erosion can be especially damaging to Lohnes and other soils having a sandy surface layer and a low or moderate available water capacity. Measures that help to control erosion also increase the amount of moisture available to crops by reducing the runoff rate, by trapping snow, and by increasing the rate of water infiltration.

Eroding sediments containing nutrients and pesticides are carried into ditches, streams, and lakes. Sediments deposited in ditches interfere with the drainage system. Removing these sediments is costly. Measures that control erosion minimize the pollution of streams and lakes and improve the quality of water for commercial use, for recreation, and for fish and wildlife.

Wetness is the major limitation on approximately half of the cropland in the county. The poorly drained or very poorly drained Augsburg, Borup, Colvin, Fargo, Northcote, Parnell, Quam, Vallers, and Viking soils are naturally so wet that crop production is unlikely or impossible unless a drainage system is installed. Draining the Fargo soils in swales commonly is difficult because drainage outlets are not readily available.

Open field ditches commonly drain excess surface water. The major ditches also can be used as outlets for subsurface tile lines. The spacing of subsurface drainage lines depends on the kind of soil and the depth at which drains can be installed.

Tilth is the physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration. Soils with good tilth are granular and porous. Soils with poor tilth have large clods, which interfere with seedbed preparation, seed germination and emergence, the uptake of nutrients by plants, and the available water capacity. Excessively cultivating moderately fine textured and fine textured soils or cultivating them when they are wet results in deterioration of tilth and in surface compaction. Fargo, Wahpeton, Northcote, and other soils that have a surface layer of clay or silty clay can be easily damaged if they are worked when wet. Tilth can be improved by returning crop residue to the soil, applying livestock manure or other organic waste, growing green manure crops, and minimizing tillage.

Natural fertility is high or medium in most of the soils in the county. It is low, however, in Langhei and in some areas of Zell soils. On most of the soils, crops respond well to applications of fertilizer. The need for fertilizer depends on the kind of soil, past and present management, the degree of erosion, and the crop to be planted. A soil test can indicate the type and amount of fertilizer to be applied. Crops do not respond so well to applications of fertilizer if the soil has such limitations as excessive wetness, droughtiness, or an imbalance of nutrients resulting from excess carbonates.

Many soils in the county have carbonates in the surface layer. Examples are Bearden, Borup, Colvin, Glyndon, Hamerly, McIntosh, Roliss, and Vallers soils. Excess carbonates in cool and wet soils can inhibit plant growth because of an imbalance with other nutrients, such as iron, zinc, phosphorus, and potassium (fig. 8).

Although insufficient moisture commonly is a limiting factor, the county has no irrigation systems. Most of the soils are not well suited to irrigation because they are too fine textured and because their available water

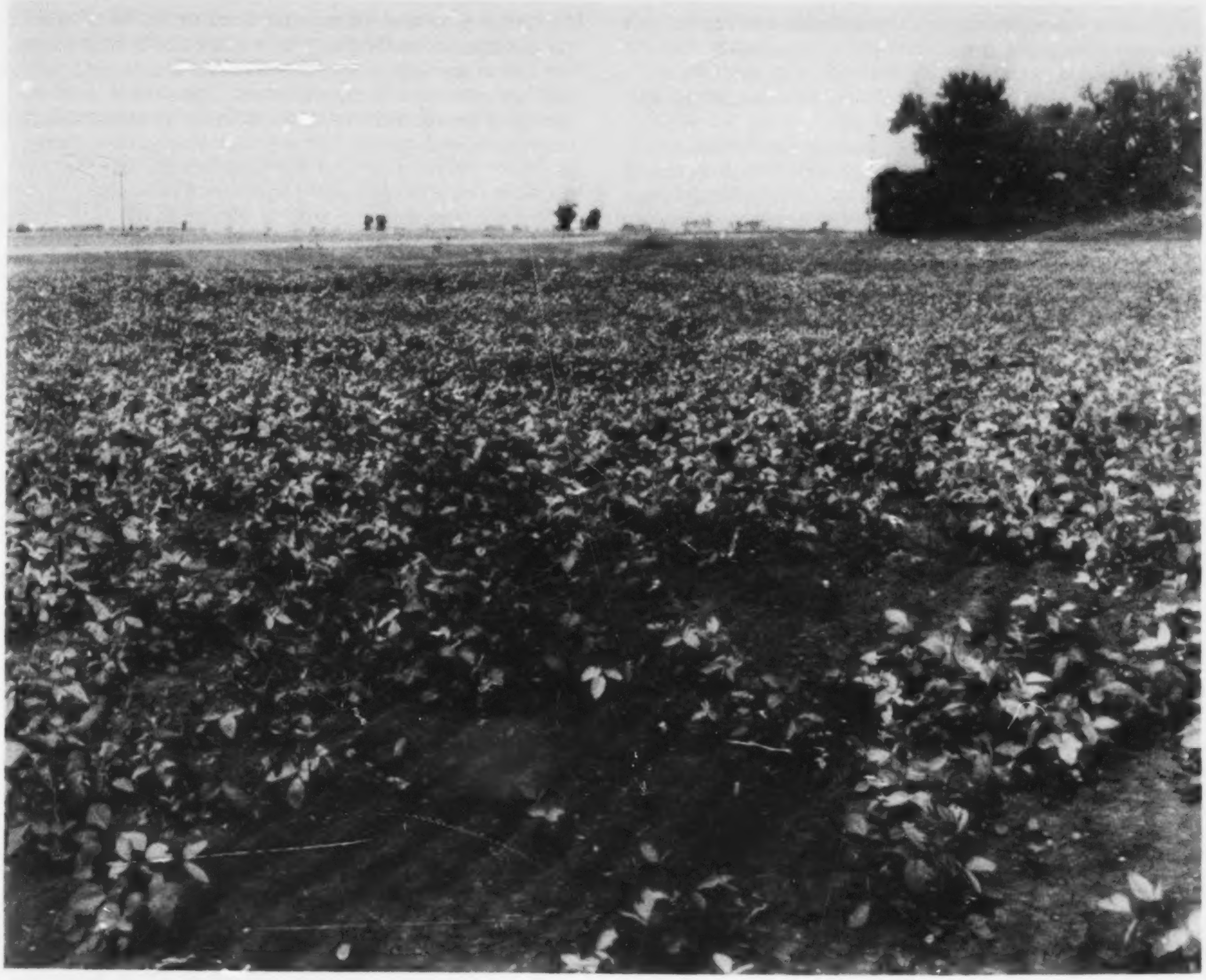


Figure 8.—Soybeans in an area of Hamerly-Lindaas silty clay loams. The light colored leaves and the bare spot result from a high content of soluble salts and a high degree of alkalinity.

capacity is too high. Also, obtaining sufficient quantities of suitable water commonly is difficult.

Areas that are too wet, too steep, or too droughty for cultivation commonly are used as permanent pasture. Existing pastures can be improved by pasture rotation, applications of fertilizer, weed control, and deferment of grazing until the grasses reach a proper height or when the soil is wet. In some areas pastures can be renovated by reseeding to more productive species. Species selection should be based on the kind of soil, the degree of wetness, and the planned period of grazing.

The moderately well drained or somewhat poorly drained Aazdahl, Grimstad, Hamerly, and Wheatville soils are suited to the widest range of forage species, including alfalfa, birdsfoot trefoil, smooth bromegrass, timothy, and reed canarygrass. Also, these soils are well suited to big bluestem and switchgrass, which are warm-season species.

Poorly drained soils, such as Fargo, Vallers, and Lamoure soils, are suited only to those forage species that can withstand wet conditions. These species include reed canarygrass, creeping foxtail, redtop, birdsfoot trefoil, alsike clover, and ladino clover. If drained, these soils also are suitable for timothy, smooth bromegrass, Kentucky bluegrass, and red clover.

Well drained or excessively drained soils, such as Rothsay, Zell, and Sioux soils, usually produce forage in the spring and early summer and again in the fall, when the amount of precipitation is adequate. During the summer months, droughty conditions limit forage production. Alfalfa, birdsfoot trefoil, smooth bromegrass, timothy, Kentucky bluegrass, and intermediate wheatgrass grow well on these soils when an adequate amount of moisture is available. Warm-season grasses, including big bluestem, little bluestem, switchgrass, and sideoats grama, also grow well on these soils. If proper management is applied, these species provide good forage during the summer. If included with cool-season species, they help to provide a full season of grazing.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

Windbreaks have been planted since the days of the early settlers to protect farmsteads and livestock. In the 1930's, they were planted to help control soil blowing. In recent years field windbreaks have been planted to trap snow and thus increase the moisture supply. Maximum growth and survival rates can be obtained by controlling weeds around newly planted trees and shrubs.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Woodland

A very small acreage in Wilkin County is used as woodland. Most of this acreage occurs as woodlots in the northeast corner of the county and as wooded areas along rivers and streams. Bur oak, maple, boxelder, and willow are the most common trees in the woodlots. Barnes, Langhei, Rothsay, Zell, and Darnen soils are common in these areas. The most common trees in the areas adjacent to rivers and streams are American elm, bur oak, hackberry, green ash, eastern cottonwood, and American basswood. Aazdahl, Bearden, Cashel, Fargo, Lamoure, and Wahpeton soils are common in these areas.

The early settlers used the trees for building material, fenceposts, and fuel. The trees and shrubs currently improve wildlife habitat and recreational areas, enhance esthetic values, and protect the watershed.

Recreation

Wilkin County offers a variety of recreational opportunities. Camping, hiking, hunting, fishing, nature study, golfing, and snowmobiling are the most common recreational activities. Recreational areas include parks in Breckenridge, Campbell, and Rothsay; an 18-hole golf course on the outskirts of Breckenridge; and a small lake formed by a dam in an area of the Otter Tail River directly east of Breckenridge. Fishing, canoeing, and boating are common recreational activities on this lake, on the Otter Tail River, and on the Red River of the North. A trap shooting club is directly northeast of Breckenridge.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Most of the soils on the nearly level lake plain in Wilkin County are intensively cultivated. Nesting areas and woody cover are typically restricted to small tracts along rivers and streams, along roads and ditches, and in field and farmstead windbreaks. The most common wildlife species in these areas are whitetail deer, rabbits, red fox, raccoon, beaver, Hungarian partridge, and pheasants.

The soils in areas of beach deposits and in the interbeach areas are level to gently sloping. Some wet soils and some open water in gravel pits and small streams are included. Much of the acreage in these areas is not good agricultural land, and much is used for hay and pasture or is idle land. The cover in these areas generally provides good habitat, and the wildlife population is relatively high. Prairie chickens, ruffed grouse, and waterfowl inhabit these areas.

Some parts of the county have very wet, mineral and organic soils. These areas provide good habitat for furbearers, such as muskrat, mink, and a few moose.

The uplands in the northeastern part of the county have wide variations in slope and drainage classes. Parts of the fields in those areas cannot be cultivated. Brushy or marshy areas or areas of open water are common. Waterfowl commonly inhabit this part of the county.

Wilkin County has a number of Nature Conservancy preserves. These include Western Prairie, Town Hall Prairie, Kettle Drummer Prairie, and Foxhome Prairie *(3)*. These areas are inhabited by some of the remaining prairie chickens in the valley prairie area. During the mating season, the prairie chickens are on these booming grounds. The male birds fan their tails, display erect feathers on their necks, and inflate orange skin sacs at the sides of their necks. These sacs serve as resonating chambers that produce a hollow booming sound that can carry as much as a mile (fig. 9).

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

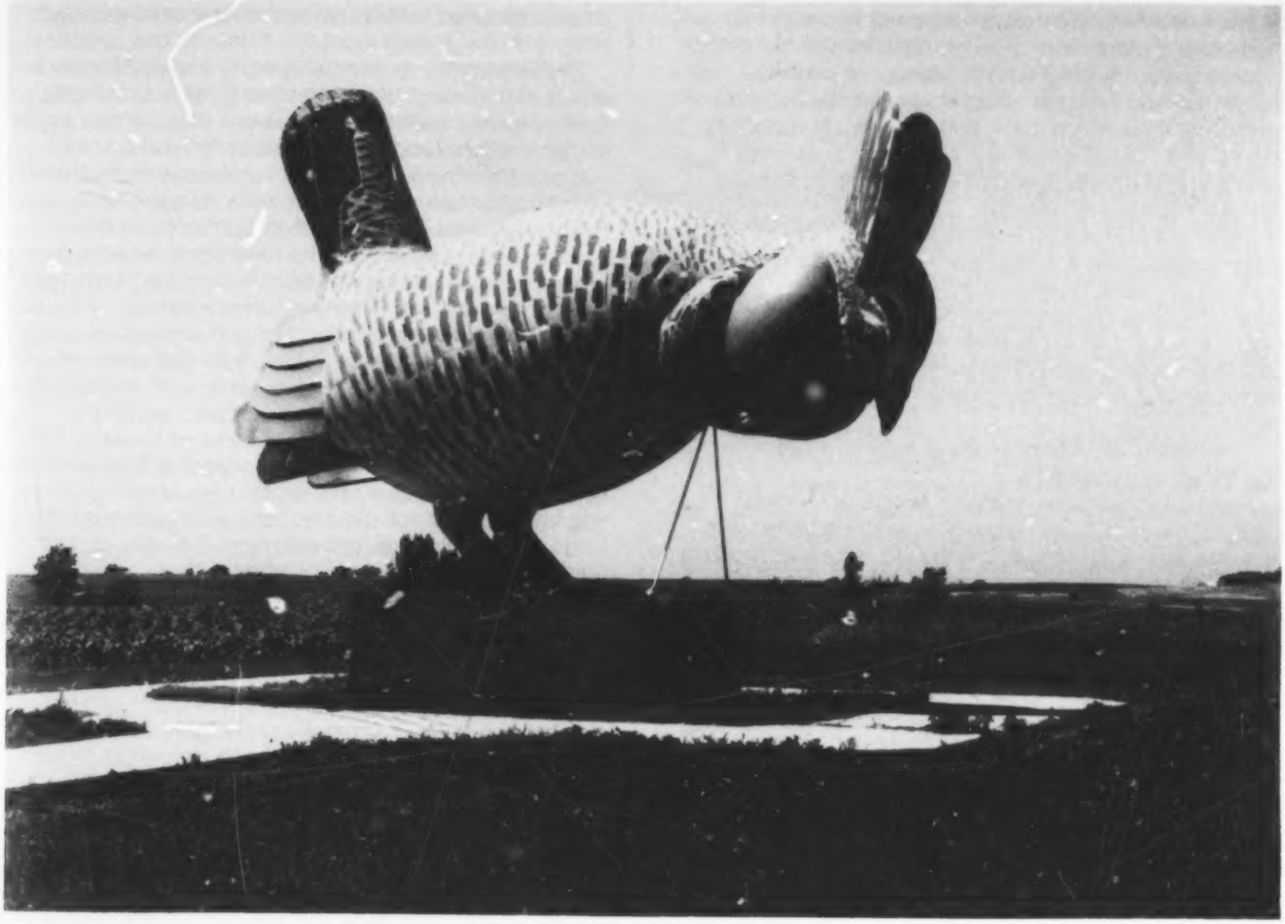


Figure 9.—A large reproduction of a booming prairie chicken in a roadside rest area near Rothsay.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big bluestem, little bluestem, western wheatgrass, blue grama, goldenrod, and beggarweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are bur oak, poplar, apple, dogwood, elm, basswood, and green ash. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, chokecherry, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl-feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include pheasant, Hungarian partridge, meadowlark, field sparrow, cottontail rabbit, prairie chicken, red fox, and deer.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include Hungarian partridge, ruffed grouse, thrushes, woodpeckers, squirrels, red fox, cottontail rabbit, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

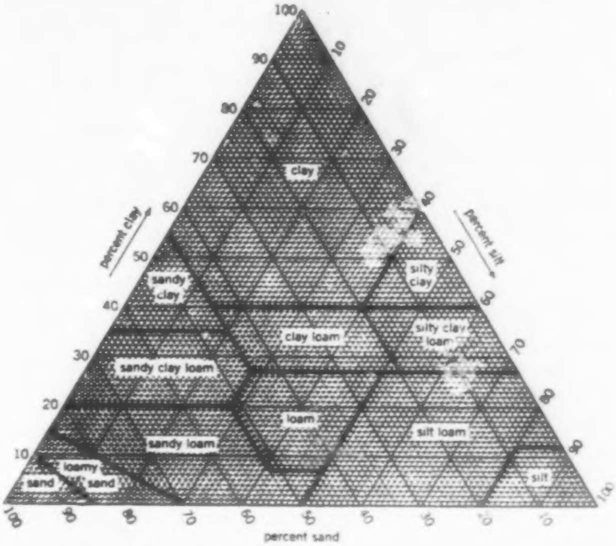


Figure 10.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 10). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous, loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(7)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Calciaquolls (*Calc*, meaning a concentration of calcium carbonate, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aeric* identifies the subgroup that is characterized by better aeration or drainage than is typical of the great group. An example is Aeric Calciaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, frigid Aeric Calciaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (6)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (7)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aazdahl Series

The Aazdahl series consists of moderately well drained, moderately slowly permeable soils on ground moraines. These soils formed in calcareous, loamy and silty glacial till. Slopes range from 0 to 3 percent.

Typical pedon of Aazdahl clay loam, 800 feet east and 1,000 feet north of the southwest corner of sec. 3, T. 130 N., R. 46 W.

Ap—0 to 12 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

Bw—12 to 18 inches; dark grayish brown (10YR 4/2) clay loam; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; clear wavy boundary.

C1—18 to 32 inches; light olive brown (2.5Y 5/4) silty clay loam; massive; friable; about 1 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

C2—32 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) mottles; massive; friable; few medium white (10YR 8/1) masses of lime; few fine black (5YR 2/1) concretions of iron; about 1 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 14 to 27 inches. The mollic epipedon is 12 to 16 inches thick. The content of coarse fragments ranges from 0 to 8 percent.

The A horizon has value of 2 or 3. It is typically clay loam, but the range includes loam and silty clay loam. The Bw horizon has hue of 2.5Y or 10YR and value of 3 or 4. In some pedons it is mottled in the lower part. It is clay loam or silty clay loam. It is neutral or mildly alkaline and has free carbonates in some pedons. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 to 4. It is clay loam, silty clay loam, silt loam, or loam. It is mildly alkaline or moderately alkaline. It has pockets of gypsum crystals in some pedons.

Arveson Series

The Averson series consists of poorly drained and very poorly drained soils on flats and in slight depressions on lake plains and outwash plains. These soils formed in calcareous, loamy lacustrine sediments overlying sandy material. Permeability is moderate or moderately rapid in the subsoil and moderately rapid or rapid in the underlying material. Slopes are 0 to 1 percent.

Typical pedon of Arveson loam, 1,935 feet east and 250 feet south of the northwest corner of sec. 29, T. 136 N., R. 45 W.

A—0 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.

Bkg1—11 to 18 inches; dark gray (2.5Y 4/1) loam; weak very fine granular structure; friable; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

Bkg2—18 to 35 inches; dark grayish brown (2.5Y 4/2) sandy loam; few fine and medium distinct yellowish brown (10YR 5/4) mottles; weak very fine granular structure; very friable; common medium soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

Cg1—35 to 42 inches; dark grayish brown (2.5Y 4/2) fine sand; common fine prominent brownish yellow (10YR 6/6) and few medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg2—42 to 60 inches; dark grayish brown (2.5Y 4/2) fine sand; streaks of very dark gray (10YR 3/1) loam; single grain; loose; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 7 to 24 inches in thickness. The depth to loamy fine sand or coarser textured sediments is more than 18 inches. The 10- to 40-inch control section is fine sandy loam, sandy loam, or loam. In some pedons the content of coarse fragments is as much as 5 percent. Some pedons have a few stones and cobbles on the surface. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 5Y, 2.5Y, or 10YR, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It is mottled in a few pedons. It is typically loam, but the range includes sandy loam, fine sandy loam, sandy clay loam, silt loam, and clay loam. Some pedons have an Ak horizon. The Bk horizon has hue of 2.5Y or 5Y, value of 4 to 7, and chroma of 1 or 2. It is dominantly sandy loam, fine sandy loam, sandy clay loam, or loam. In some pedons, however, it is loamy sand or loamy fine sand in the lower part. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is mottled in some pedons. It is sand, fine sand, loamy sand, loamy fine sand, sandy loam, or fine sandy loam.

Augsburg Series

The Augsburg series consists of poorly drained soils on lake plains. These soils formed in a mantle of loamy sediments and in the underlying clayey or silty lacustrine sediments. Permeability is moderately rapid in the upper part of the profile and slow or very slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Augsburg very fine sandy loam, 80 feet west and 50 feet north of the southeast corner of sec. 13, T. 132 N., R. 46 W.

A—0 to 13 inches; black (10YR 2/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; some bleached sand grains; strong effervescence; mildly alkaline; clear smooth boundary.

Bkg—13 to 20 inches; gray (2.5Y 5/1) very fine sandy loam; weak very fine granular structure; very friable; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

Cg—20 to 27 inches; light brownish gray (2.5Y 6/2) loamy very fine sand; common fine distinct olive yellow (2.5Y 6/8) and common fine prominent yellowish brown (10YR 5/8) mottles; massive; loose; slight effervescence; mildly alkaline; clear smooth boundary.

2Cg1—27 to 32 inches; gray (5Y 5/1) silty clay; common medium prominent strong brown (7.5YR 4/6 and 5/8) mottles; weak very fine subangular blocky structure; sticky; strong effervescence; mildly alkaline; clear smooth boundary.

2Cg2—32 to 60 inches; light gray (5Y 6/1) silty clay; many medium prominent yellow (2.5Y 7/8), yellowish brown (10YR 5/8), and dark brown (7.5YR 3/4) mottles; massive; sticky; strong effervescence; mildly alkaline.

The mollic epipedon ranges from 7 to 18 inches in thickness. The depth to the 2C horizon ranges from 20 to 40 inches. Reaction is mildly alkaline or moderately alkaline to a depth of 40 inches or more.

The A horizon generally has value of 2 or 3 and chroma of 1 or 2. In some pedons, however, it is neutral in hue and has value of 2 or 3 and chroma of 0. It is typically very fine sandy loam, but the range includes loam, silt loam, and sandy clay loam. The Bk and C horizons have hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. They are loam, very fine sandy loam, silt loam, or loamy very fine sand. The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It has faint to prominent mottles in some pedons. It is silty clay, clay, or silty clay loam.

Barnes Series

The Barnes series consists of well drained, moderately permeable soils on till plains. These soils formed in loamy glacial till. Slopes range from 1 to 18 percent.

Typical pedon of Barnes loam, 1 to 6 percent slopes, 1,350 feet west and 550 feet north of the southeast corner of sec. 15, T. 136 N., R. 45 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; very friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

Bw1—10 to 15 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; about 2 percent coarse fragments; neutral; clear smooth boundary.

Bw2—15 to 20 inches; dark grayish brown (10YR 4/2) loam; weak fine subangular blocky structure; very friable; about 3 percent coarse fragments; neutral; clear smooth boundary.

C1—20 to 32 inches; light olive brown (2.5Y 5/4) loam; massive; friable; about 2 percent coarse fragments; mildly alkaline; strong effervescence; gradual smooth boundary.

C2—32 to 37 inches; light olive brown (2.5Y 5/4) loam; massive; friable; about 2 percent coarse fragments; mildly alkaline; strong effervescence; gradual smooth boundary.

C3—37 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many medium distinct light yellowish brown (10YR 6/4) and dark grayish brown (2.5Y 4/2) mottles; massive; friable; about 2 percent coarse fragments; mildly alkaline; strong effervescence.

The thickness of the solum ranges from 10 to 30 inches. The mollic epipedon is 7 to 16 inches thick. The content of coarse fragments is 0 to 5 percent throughout the profile.

The A horizon has value of 2 or 3. It is typically loam, but sandy loam, fine sandy loam, sandy clay loam, silt loam, and clay loam are within the range. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 5, and chroma of 2 to 4. It is loam, sandy clay loam, or clay loam. Some pedons have a Bk or BC horizon. The C horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4. It has few to many mottles.

Bearden Series

The Bearden series consists of somewhat poorly drained soils on lake plains. These soils formed in silty, calcareous lacustrine material. Permeability is moderate or moderately slow in the upper part of the profile and slow to moderate in the lower part. Slopes range from 0 to 6 percent.

Typical pedon of Bearden silty clay loam, 50 feet south and 650 feet west of the northeast corner of sec. 15, T. 135 N., R. 48 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.

Ak—9 to 15 inches; very dark gray (2.5Y 3/1) silty clay loam, dark gray (2.5Y 4/1) dry; weak very fine subangular blocky structure; very friable; few fine soft white (5Y 8/1) masses of calcium carbonate; strong effervescence; mildly alkaline; clear smooth boundary.

Bk1—15 to 24 inches; grayish brown (2.5Y 5/2) silt loam; weak very fine subangular blocky structure; very friable; common medium soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; gradual smooth boundary.

Bk2—24 to 33 inches; grayish brown (2.5Y 5/2) silt loam; few fine distinct yellowish brown (10YR 5/8) mottles; weak very fine subangular blocky structure; very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—33 to 39 inches; light olive brown (2.5Y 5/4) silt loam; common medium distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/8) mottles; weak medium to very fine subangular blocky structure; friable; common medium distinct white (2.5Y 8/1) masses of lime; strong effervescence; mildly alkaline; clear smooth boundary.

C2—39 to 60 inches; grayish brown (2.5Y 5/2) silt loam; many medium prominent yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure with some laminations; very friable; few medium prominent yellowish red (5YR 3/6) concretions of iron; few fine distinct white (2.5Y 8/1) masses of lime; strong effervescence; mildly alkaline.

The mollic epipedon ranges from 7 to 20 inches in thickness. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The Ap or A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of less than 2. It is typically silty clay loam, but loam, silt loam, and clay loam are within the range. Some pedons have an AB horizon. The Bk horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 to 4. It has few, faint to prominent mottles in the lower part. The C horizon has value of 4 to 6 and chroma of 2 to 4. It has few to many, faint to prominent mottles. It is silty clay loam or silt loam. In some pedons it has numerous pockets of gypsum crystals.

Borup Series

The Borup series consists of poorly drained, moderately rapidly permeable soils on lake plains. These soils formed in loamy material over sandy sediments. Slopes are 0 to 1 percent.

Typical pedon of Borup loam, 75 feet west and 280 feet north of the southeast corner of sec. 8, T. 135 N., R. 47 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium granular structure; friable; mildly alkaline; strong effervescence; clear smooth boundary.

Bk1—10 to 19 inches; dark grayish brown (2.5Y 4/2) loam; weak very fine granular structure; very friable; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—19 to 25 inches; grayish brown (2.5Y 5/2) very fine sandy loam; few fine prominent yellowish brown (10YR 5/6 and 5/8) mottles; weak very fine granular structure; very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C—25 to 60 inches; gray (5Y 5/1) loamy very fine sand; many medium and coarse prominent yellowish brown (10YR 5/6) and few fine prominent yellowish brown (10YR 5/8) mottles; massive; very friable; few fine prominent black (10YR 2/1) concretions; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The Ap horizon generally has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 1. In some pedons, however, it is neutral in hue and has value of 2 or 3 and chroma of 0. It is typically loam, but the range includes very fine sandy loam, silt loam, silty clay loam, and sandy clay loam. The Bk horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is dominantly loamy very fine sand, very fine sandy loam, loam, or silt loam, but in some pedons it has strata of sandy clay loam. The C horizon has colors similar to those of the Bk horizon. It has few to many, distinct or prominent mottles. It is dominantly loamy very fine sand or very fine sand, but in some pedons it has layers of very fine sandy loam.

Cashel Series

The Cashel series consists of somewhat poorly drained, slowly permeable or moderately slowly permeable soils on flood plains. These soils formed in clayey recent alluvium. Slopes range from 1 to 3 percent.

Typical pedon of Cashel silty clay, 3,050 feet west and 1,350 feet north of the southeast corner of sec. 3, T. 134 N., R. 48 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silty clay, gray (10YR 5/1) dry; moderate very fine subangular blocky structure; friable and firm; slight effervescence; mildly alkaline; clear smooth boundary.

C—9 to 12 inches; very dark grayish brown (2.5Y 3/2) silty clay; weak very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Ab1—12 to 20 inches; very dark brown (10YR 2/2) silty clay; moderate very fine and fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Ab2—20 to 29 inches; very dark brown (10YR 2/2) silty clay; moderate very fine to medium subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C'1—29 to 39 inches; dark grayish brown (2.5Y 4/2) silty clay; weak very fine to medium subangular blocky structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

C'2—39 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay; very dark gray (10YR 3/1) stains and streaks; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky and moderate very fine angular blocky structure; firm; few fine masses of lime; strong effervescence; mildly alkaline.

The 10- to 40-inch control section typically is silty clay, but in some pedons it has layers or horizons of silty clay loam or clay or fine strata of silt loam. Some pedons have fragments of woody material and snail shells.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It typically is silty clay, but the range includes silty clay loam and clay. The C horizon has hue of 2.5Y or 5Y, value of 2 to 5, and chroma of 1 to 3. It typically is laminated silty clay or silty clay loam, but in some pedons it has strata of silt loam.

Clearwater Series

The Clearwater series consists of poorly drained, slowly permeable soils on lake plains. These soils formed in clayey, calcareous glacial till or lacustrine sediments. Slopes range from 0 to 2 percent.

Typical pedon of Clearwater sandy clay loam, 45 feet south and 1,505 feet east of the northwest corner of sec. 26, T. 135 N., R. 47 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy clay loam, very dark gray (10YR 3/1) dry; moderate medium and coarse subangular blocky structure parting to moderate fine granular; friable; common very fine bleached sand grains; neutral; abrupt smooth boundary.

Bg—9 to 17 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry; few medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; strong very fine angular blocky structure; firm, sticky; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—17 to 24 inches; olive gray (5Y 4/2) clay; few fine prominent light olive brown (2.5Y 5/6) mottles; massive; firm, sticky; slight effervescence; mildly alkaline; clear smooth boundary.

Cg2—24 to 31 inches; olive gray (5Y 5/2) silty clay; common fine and medium prominent olive yellow (2.5Y 6/6 and 6/8) mottles; massive; firm, sticky; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg3—31 to 60 inches; olive gray (5Y 5/2) silty clay; many fine and medium prominent yellow (2.5Y 7/6 and 7/8) mottles; massive; very firm, sticky; many medium white (5Y 8/1) masses of lime; strong effervescence; moderately alkaline.

The solum ranges from 12 to 24 inches in thickness. In some pedons it is calcareous throughout. The content of coarse fragments is 0 to 8 percent in the solum.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 and chroma of 0. It is typically sandy clay loam, but the range includes clay, silty clay, silty clay loam, clay loam, loam, and fine sandy loam. This horizon is neutral or mildly alkaline. The Bg and C horizons are mildly alkaline or moderately alkaline. The Bg horizon has hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It has few to many, distinct or prominent mottles. It is typically clay or silty clay, but in some pedons it is silty clay loam below a depth of 36 inches.

Colvin Series

The Colvin series consists of poorly drained, slowly permeable or moderately slowly permeable soils on lake plains. These soils formed in silty and clayey lacustrine sediments. Slopes are less than 2 percent.

Typical pedon of Colvin silty clay loam, 555 feet west and 880 feet south of the northeast corner of sec. 15, T. 135 N., R. 48 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bkg1—9 to 15 inches; olive gray (5Y 5/2) silt loam; weak very fine subangular blocky structure; very friable; common fine distinct soft white (5Y 8/1) masses of calcium carbonate and pockets of fine gypsum crystals; violent effervescence; moderately alkaline; gradual smooth boundary.

Bkg2—15 to 24 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct light olive brown (2.5Y 5/6) mottles; weak very fine to medium subangular blocky structure; very friable; many medium soft light gray (5Y 7/1) masses of calcium carbonate and pockets of gypsum crystals; violent effervescence; moderately alkaline; clear smooth boundary.

Cg1—24 to 33 inches; olive gray (5Y 5/2) silt loam; many medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; weak very fine to medium subangular blocky structure; very friable; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg2—33 to 60 inches; olive gray (5Y 5/2) silt loam; many fine prominent yellowish brown (10YR 5/8), olive yellow (2.5Y 6/6), and yellow (2.5Y 7/8) mottles; massive; very friable; few fine prominent yellowish red (5YR 5/8) masses of iron; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 7 to 24 inches in thickness. In some pedons it extends into the calcic horizon. The top of the calcic horizon is within 16 inches of the surface. The solum is silt loam or silty clay loam.

The A or Ap horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. Some pedons have an Ak or ABk horizon. This horizon has hue of 2.5Y or 5Y or is neutral in hue. It has value of 3 to 6 and chroma of 0 to 2. The Bkg horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 3 to 6 and chroma of 0 to 2. The Cg horizon has hue of 2.5Y or 5Y, value of 3 to 6, and chroma of 1 to 3. It typically has few to many mottles with chroma of 3 to 8. The mottles are of low chroma where the matrix has chroma of 3. This horizon is dominantly silt loam or silty clay loam. In some pedons, however, it has more sand, silt, or clay below a depth of 40 inches.

Darnen Series

The Darnen series consists of moderately well drained, moderately permeable soils on moraines. These soils formed in loamy colluvial material. Slopes range from 0 to 3 percent.

Typical pedon of Darnen silt loam, 1,300 feet north and 1,500 feet west of the southeast corner of sec. 11, T. 135 N., R. 45 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; about 2 percent coarse fragments; slight effervescence; neutral; abrupt smooth boundary.

A—9 to 24 inches; very dark gray (10YR 3/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

Bw—24 to 35 inches; dark yellowish brown (10YR 4/4) clay loam; weak very fine subangular blocky structure; friable; many fine bleached sand grains; neutral; clear smooth boundary.

C—35 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine distinct brownish yellow (10YR 6/6) mottles; weak very fine subangular blocky structure; friable; about 2 percent coarse fragments; many fine bleached sand grains; some pockets of black (10YR 2/1) material; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 50 inches. The mollic epipedon ranges from 20 to 48 inches in thickness. In some pedons the content of gravel is as much as 5 percent, mostly in the lower part of the control section and in the C horizon. In some pedons lenses of sand and loamy sand less than 6 inches thick are in the lower part of the control section.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically silt loam, but the range includes loam, sandy loam, and clay loam. The B horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is loam, silt loam, sandy loam, or clay loam. Some pedons are not mottled below a depth of 36 inches. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is loam or clay loam.

Deerwood Series

The Deerwood series consists of very poorly drained soils in depressions on lake plains. These soils formed in a thin layer of organic material and in the underlying sandy lacustrine material. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Slopes are typically less than 1 percent.

Typical pedon of Deerwood muck, 1,280 feet north and 1,300 feet east of the southwest corner of sec. 19, T. 135 N., R. 46 W.

Oa—0 to 12 inches; black (10YR 2/1) muck; moderate very fine granular structure; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

Ag—12 to 16 inches; black (5Y 2/1) loamy fine sand; dark gray (5Y 4/1) streaks; single grain; loose; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—16 to 28 inches; olive gray (5Y 5/2) fine sand and sand; black (5Y 2/1) streaks; few fine distinct yellowish brown (10YR 5/6) and light yellowish brown (10YR 6/4) mottles; single grain; loose; slight effervescence; mildly alkaline; clear smooth boundary.

Cg2—28 to 36 inches; grayish brown (2.5Y 5/2) fine sand and sand; common fine distinct brownish yellow (10YR 6/6) and yellowish brown (10YR 5/6) mottles; single grain; loose; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg3—36 to 60 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) fine sand and sand; few fine faint pale olive (5Y 6/4) mottles; single grain; loose; slight effervescence; mildly alkaline.

The histic epipedon is 8 to 16 inches thick, and the Ag horizon is 2 to 7 inches thick. Reaction ranges from moderately alkaline to medium acid to a depth of 60 inches or more. In some pedons the organic surface layer is neutral.

The O horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2. It typically is sapric material throughout, but in some pedons it has hemic material or woody fibers. The Ag horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 and chroma of 0. It is sand, fine sand, loamy coarse sand, loamy fine sand, coarse sandy loam, sandy loam, or fine sandy loam. The Cg horizon has hue of 5Y or 2.5Y, value of 4 to 7, and chroma of 1 or 2. It is loose or very friable. It is coarse sand, sand, fine sand, loamy coarse sand, loamy sand, or loamy fine sand. In some pedons the content of coarse fragments is as much as 35 percent in this horizon.

Divide Series

The Divide series consists of somewhat poorly drained and moderately well drained soils on outwash plains. These soils formed in loamy alluvium and in the underlying sandy and gravelly material. Permeability is moderate in the upper part of the profile and rapid or very rapid in the underlying material. Slopes range from 0 to 3 percent.

Typical pedon of Divide loam, 100 feet north and 1,850 feet east of the southwest corner of sec. 27, T. 136 N., R. 46 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

Ak—9 to 15 inches; very dark gray (10YR 3/1) loam, gray (2.5Y 5/1) dry; weak fine subangular blocky structure; friable; few fine soft white (5Y 8/1) masses of calcium carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

Bk—15 to 23 inches; dark gray (10YR 4/1) loam; weak fine granular structure; very friable; common medium soft white (5Y 8/1) masses of calcium carbonate; strong effervescence; mildly alkaline; clear smooth boundary.

2C1—23 to 38 inches; olive (5Y 5/3) very gravelly loamy sand; few fine distinct yellowish brown (10YR 5/4) mottles; massive; loose; about 40 percent gravel; strong effervescence; mildly alkaline; gradual smooth boundary.

2C2—38 to 60 inches; light olive brown (2.5Y 5/4), stratified fine sand and gravelly sand; common fine and medium prominent brownish yellow (10YR 6/6 and 6/8) mottles; massive; loose; about 20 percent gravel; slight effervescence; common fine prominent black (10YR 2/1) concretions of iron; mildly alkaline.

The depth to sand and gravelly sand ranges from 20 to 36 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has hue of 10YR or 2.5Y and value of 2 or 3. It is loam, sandy loam, silt loam, or clay loam. Some pedons do not have an Ak horizon. The Bk horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 4. It is loam or clay loam. The 2C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7, and chroma of 2 to 6. It is dominantly very gravelly loamy sand and gravelly sand but has some strata of fine sand.

Donaldson Series

The Donaldson series consists of somewhat poorly drained and moderately well drained soils on lake plains. These soils formed in loamy lacustrine sediments over clayey lacustrine sediments or clayey till. They are moderately rapidly permeable in the upper part and slowly permeable in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Donaldson very fine sandy loam, 620 feet west and 100 feet north of the southeast corner of sec. 29, T. 135 N., R. 46 W.

Ap—0 to 9 inches; black (10YR 2/1) very fine sandy loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; common bleached sand grains; neutral; clear smooth boundary.

Bw—9 to 19 inches; dark grayish brown (10YR 4/2) very fine sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.

C—19 to 30 inches; light yellowish brown (2.5Y 6/4) loamy very fine sand; few medium distinct brownish yellow (10YR 6/8) mottles; massive; very friable; neutral; abrupt smooth boundary.

2C—30 to 60 inches; dark gray (5Y 4/1) silty clay; few fine and medium prominent light olive brown (2.5Y 5/6) mottles; weak very fine subangular blocky structure; firm; common medium prominent soft white (5Y 8/2) masses of lime; few fine distinct black (10YR 2/1) concretions of iron; slight effervescence; mildly alkaline.

The thickness of solum and the depth to free carbonates range from 10 to 30 inches. The thickness of the coarse-loamy sediments ranges from 20 to 40 inches. The mollic epipedon is 8 to 16 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is fine sandy loam, very fine sandy loam, sandy clay loam, or loam. The B horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 or 3. In some pedons it has no mottles. It is loamy very fine sand, fine sandy loam, very fine sandy loam, or loam. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 or 4. It has faint to prominent mottles. It is very fine sand, loamy very fine sand, very fine sandy loam, or fine sandy loam. It is neutral to moderately alkaline. The 2C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It has few to many mottles or light colored masses of lime. It is typically clay or silty clay, but silty clay loam and clay loam are within the range. This horizon is mildly alkaline or moderately alkaline.

Doran Series

The Doran series consists of somewhat poorly drained, slowly permeable or moderately slowly permeable soils on lake plains and water-modified till plains. These soils formed in lacustrine material over glacial till. Slopes are less than 2 percent.

Typical pedon of Doran clay loam, 1,370 feet west and 150 feet north of the southeast corner of sec. 7, T. 130 N., R. 46 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

Bt1—9 to 14 inches; very dark grayish brown (2.5Y 3/2) clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine subangular blocky; very firm; a few pebbles; neutral; clear smooth boundary.

Bt2—14 to 22 inches; dark grayish brown (2.5Y 4/2) clay; few fine distinct light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure parting to moderate very fine subangular blocky; firm; a few pebbles; neutral; clear wavy boundary.

Bk—22 to 36 inches; olive gray (5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; common medium soft white (5Y 8/1) masses of calcium carbonate; strong effervescence; common gypsum crystals; common soft masses of lime; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; olive (5Y 4/3) clay loam; common fine and medium prominent yellowish brown (10YR 5/8) and few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; firm; a few pebbles; common gypsum crystals; common soft masses of lime; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 12 to 24 inches. The mollic epipedon is 7 to 16 inches thick. The soils are neutral in the upper horizons and range to moderately alkaline in the lower horizons.

The A horizon is clay loam, silty clay loam, or loam. The Bt horizon has hue of 2.5Y or 10YR, value of 2 to 4, and chroma of 1 to 3. In some pedons it is not mottled in the lower part. It is clay loam or clay in which the content of coarse fragments is 0 to 5 percent. The Bk horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 3. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 4. In some pedons it has no gypsum crystals. The content of coarse fragments in this horizon is 3 to 10 percent.

Elmville Series

The Elmville series consists of somewhat poorly drained soils in lake basins. These soils formed in sandy and loamy material over clayey sediments. Permeability is moderately rapid in the upper part of the profile and slow in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Elmville very fine sandy loam, 1,056 feet west and 2,112 feet north of the southeast corner of sec. 3, T. 130 N., R. 45 W.

Ap—0 to 9 inches; black (10YR 2/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine and very fine subangular blocky; very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

Ak—9 to 15 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak fine and very fine subangular blocky; very friable; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

Bk—15 to 21 inches; grayish brown (2.5Y 5/2) loamy very fine sand; weak medium subangular blocky structure; very friable; common fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

C1—21 to 26 inches; light olive brown (2.5Y 5/4) loamy very fine sand; single grain; loose; slight effervescence; mildly alkaline; clear smooth boundary.

C2—26 to 34 inches; light yellowish brown (2.5Y 6/4) very fine sand; common medium faint light olive brown (2.5Y 5/4) and few fine distinct brownish yellow (10YR 6/6) mottles; single grain; loose; slight effervescence; mildly alkaline; clear smooth boundary.

2C—34 to 60 inches; olive gray (5Y 5/2) silty clay; common fine and medium prominent yellowish red (5YR 4/6) and yellowish brown (10YR 5/6 and 5/8) mottles; massive; firm; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The top of the calcic horizon is within 16 inches of the surface. The depth to clayey sediments ranges from 20 to 40 inches.

The A, Bk, and C horizons are mildly alkaline or moderately alkaline. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is typically very fine sandy loam, but the range includes fine sandy loam, loamy very fine sand, loamy fine sand, and sandy loam. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or 3. It is mottled in some pedons. It is loamy fine sand, very fine sandy loam, loamy very fine sand, or fine sandy loam. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 4. It is mottled in some or all parts. It is loamy very fine sand, fine sandy loam, very fine sand, loamy fine sand, or fine sand. The 2C horizon has hue of 2.5Y or 5Y, value of 3 to 6, and chroma of 1 to 3. It is silty clay loam, silty clay, or clay.

Enloe Series

The Enloe series consists of poorly drained, slowly permeable soils in shallow basins and swales on lake plains. These soils formed in clayey lacustrine sediments. Slopes are 0 to 1 percent.

Typical pedon of Enloe silty clay loam, in an area of Fargo-Enloe complex; 656 feet west and 650 feet north of the southeast corner of sec. 9, T. 132 N., R. 47 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate fine granular; friable; neutral; abrupt smooth boundary.

E—9 to 14 inches; very dark gray (10YR 3/1) silty clay loam, light gray (10YR 6/1) dry; weak medium platy structure parting to moderate fine granular; friable; neutral; abrupt wavy boundary.

Btg1—14 to 18 inches; black (5Y 2/1) clay; moderate medium prismatic structure parting to strong fine subangular blocky; very firm; very dark gray (5Y 3/1) coatings on faces of peds; neutral; clear wavy boundary.

Btg2—18 to 26 inches; very dark gray (5Y 3/1) clay; moderate medium prismatic structure parting to strong fine angular blocky; very firm; very dark gray (5Y 3/1) coatings on faces of peds; neutral; clear wavy boundary.

BCg—26 to 33 inches; olive gray (5Y 4/2) clay; few fine distinct brown (10YR 5/3) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; strong effervescence; mildly alkaline; clear smooth boundary.

Cg—33 to 60 inches; dark gray (5Y 4/1) clay; weak fine subangular blocky structure; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 48 inches. The mollic epipedon is 7 to 14 inches thick.

The Ap and E horizons are silty clay loam or silty clay. The Ap horizon has hue of 10YR, 2.5Y, or 5Y and value of 2 or 3. The E horizon has hue of 10YR, 2.5Y, or 5Y and value of 3 to 5. It has distinct or prominent mottles in some pedons. The Btg horizon has hue of 2.5Y or 5Y, value of 2 to 4, and chroma of 1 or 2. Some pedons do not have a BCg horizon. The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 3. It is mottled in some pedons. It is clay, silty clay loam, or silt loam. The content of calcium carbonate in this horizon ranges from 6 to 20 percent. Some pedons have clay loam or clay glacial till below a depth of about 40 inches.

Espelie Series

The Espelie series consists of poorly drained soils on lake plains. These soils formed in sandy lacustrine sediments over clayey glacial till or lacustrine sediments. Permeability is moderately rapid in the sandy sediments and slow in the clayey underlying material. Slopes are 0 to 1 percent.

Typical pedon of Espelie fine sandy loam, 1,480 feet south and 50 feet west of the northeast corner of sec. 27, T. 135 N., R. 47 W.

A—0 to 11 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; very friable; neutral; clear smooth boundary.

Bg—11 to 16 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; common fine distinct dark yellowish brown (10YR 4/6) and light olive brown (2.5Y 5/6) mottles; single grain; loose; neutral; clear smooth boundary.

Cg—16 to 27 inches; grayish brown (2.5Y 5/2) fine sand; many fine and medium prominent dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/8) mottles; single grain; loose; neutral; abrupt smooth boundary.

2Cg—27 to 60 inches; gray (5Y 5/1) silty clay; common fine prominent dark yellowish brown (10YR 4/4 and 4/6) mottles; massive; firm, very sticky; slight effervescence; mildly alkaline.

The mollic epipedon is 6 to 14 inches thick. The depth to clayey material ranges from 20 to 40 inches. The depth to free carbonates ranges from 15 to 40 inches. A gravelly stone line as thick as 6 inches is at the base of the sandy material.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is fine sandy loam or sandy loam. The Bg and Cg horizons are loamy fine sand, fine sand, loamy sand, or sand. The Bg horizon has value of 3 or 4 and chroma of 1 or 2. It has distinct or prominent mottles. The Cg horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. The 2Cg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is typically clay or silty clay, but the range includes silty clay loam.

Fargo Series

The Fargo series consists of poorly drained, slowly permeable soils on lake plains. These soils formed in clayey lacustrine material. Slopes range from 0 to 6 percent.

Typical pedon of Fargo silty clay, 0 to 2 percent slopes, 50 feet east and 890 feet north of the southwest corner of sec. 5, T. 136 N., R. 48 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; sticky; neutral; abrupt smooth boundary.

A—8 to 11 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; sticky; neutral; clear smooth boundary.

BA—11 to 15 inches; black (5Y 2/2) clay; moderate very fine subangular blocky structure; very sticky; cracks filled with material from the A horizon extend through this horizon; neutral; clear broken boundary.

Bg—15 to 20 inches; dark olive gray (5Y 3/2) clay; moderate very fine subangular blocky structure; very sticky; cracks filled with material from the A horizon extend through this horizon; neutral; clear smooth boundary.

Bkg1—20 to 30 inches; olive gray (5Y 4/2) clay; moderate very fine subangular blocky structure; sticky; few fine soft white (5Y 8/1) masses of calcium carbonate; cracks filled with material from the A horizon extend through this horizon; strong effervescence; neutral; clear smooth boundary.

Bkg2—30 to 42 inches; olive gray (5Y 4/2) silty clay; weak very fine subangular blocky structure; sticky; common medium soft white (5Y 8/1) masses of calcium carbonate; strong effervescence; neutral; clear smooth boundary.

Cg—42 to 60 inches; olive gray (5Y 4/2) silty clay; common fine distinct olive yellow (2.5Y 6/6) and few fine distinct light gray (2.5Y 7/1) mottles; massive; sticky; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 48 inches. The mollic epipedon ranges from 8 to 24 inches in thickness. The depth to free carbonates ranges from 11 to 25 inches.

The A and Ap horizons have hue of 10YR, 2.5Y, or 5Y or are neutral in hue. They have value of 1 or 2. They are silty clay loam, silty clay, or clay. The Bg horizon is mottled in some pedons. The Bkg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. The content of calcium carbonate in this horizon ranges from 10 to 25 percent. The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 3. It typically has common or many, distinct or prominent mottles. In some pedons it is silty clay loam in which the content of clay is less than 35 percent. In some pedons laminated sediments of silty clay, clay, and silty clay loam are at a depth of 24 to 60 inches.

Flaming Series

The Flaming series consists of moderately well drained, rapidly permeable soils on lake plains. These soils formed in sandy deposits. Slopes range from 0 to 2 percent.

Typical pedon of Flaming loamy fine sand, 260 feet north and 140 feet west of the southeast corner of sec. 28, T. 135 N., R. 47 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak medium and fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

AB—9 to 13 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark gray (10YR 4/1) dry; weak medium and fine subangular blocky structure; very friable; neutral; clear wavy boundary.

Bw1—13 to 16 inches; dark brown (10YR 4/3) fine sand; single grain; very friable; neutral; gradual wavy boundary.

Bw2—16 to 22 inches; dark grayish brown (10YR 4/2) fine sand; single grain; loose; neutral; clear wavy boundary.

C1—22 to 28 inches; pale brown (10YR 6/3) fine sand; few fine distinct brownish yellow (10YR 6/6) mottles; single grain; loose; strong effervescence; moderately alkaline; clear wavy boundary.

C2—28 to 60 inches; grayish brown (2.5Y 5/2) fine sand; few fine distinct brownish yellow (10YR 6/6 and 6/8) and many medium distinct yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) mottles; single grain; loose; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. It is fine sand or loamy fine sand. The depth to free carbonates ranges from 20 to 60 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has hue of 10YR in the upper part and hue of 10YR or 2.5Y in the lower part. It has value of 3 to 5 and chroma of 2 to 4. The C horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 3. It is typically fine sand, but in some pedons it is sand in the lower part. It ranges from medium acid to moderately alkaline.

Foldahl Series

The Foldahl series consists of moderately well drained soils on lake plains. These soils formed in sandy material over loamy material. Permeability is rapid in the sandy sediments and moderately slow or moderate in the loamy sediments. Slopes range from 0 to 3 percent.

Typical pedon of Foldahl loamy fine sand, 50 feet south and 1,580 feet east of the northwest corner of sec. 2, T. 136 N., R. 46 W.

A—0 to 10 inches; very dark brown (10YR 2/2) loamy fine sand, dark gray (10YR 4/1) dry; blotches of black (10YR 2/1) material; weak coarse subangular blocky structure parting to weak very fine granular; very friable; many bleached fine sand grains; neutral; clear smooth boundary.

AB—10 to 13 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark gray (10YR 4/1) dry; weak medium and coarse subangular blocky structure parting to weak very fine granular; very friable; neutral; clear smooth boundary.

Bw—13 to 22 inches; dark yellowish brown (10YR 4/4) fine sand that has pockets of loamy fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; a stone line at the base of the horizon; neutral; clear smooth boundary.

2C1—22 to 34 inches; pale brown (10YR 6/3) loam; common fine and medium distinct brownish yellow (10YR 6/6 and 6/8) mottles; weak very fine subangular blocky structure; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

2C2—34 to 60 inches; light brownish gray (2.5Y 6/2) loam; many medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; weak very fine subangular blocky structure; friable; strong effervescence; mildly alkaline.

The thickness of solum and the depth to free carbonates range from 16 to 32 inches. The mollic epipedon is 7 to 16 inches thick. The sandy sediments range from 20 to 40 inches in thickness. They typically have no coarse fragments in the upper part, but the content of these fragments is as much as 5 percent in some pedons. The stone line, if it occurs, is as much as 6 inches thick. The content of coarse fragments is as much as 35 percent in the stone line.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly loamy sand or loamy fine sand but in some pedons is sandy loam or fine sandy loam. It is slightly acid to mildly alkaline. The B horizon has value of 3 or 4 and chroma of 2 to 4. It is sand, fine sand, loamy sand, or loamy fine sand. It is neutral or mildly alkaline. Some pedons have a BC horizon or a C horizon, both of which formed in the sandy sediments. These horizons have hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. They commonly are mottled. Their range in texture is the same as that of the B horizon. The 2C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 2 to 4. It has few to many mottles. It is fine sandy loam, loam, silt loam, clay loam, or silty clay loam. It is mildly alkaline or moderately alkaline.

Fossum Series

The Fossum series consists of poorly drained, rapidly permeable soils on lake plains. These soils formed mainly in calcareous, sandy deposits. Slopes are 0 to 1 percent.

Typical pedon of Fossum loamy fine sand, 350 feet east and 1,550 feet north of the southwest corner of sec. 1, T. 136 N., R. 46 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine granular; very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

Ak—8 to 12 inches; very dark gray (10YR 3/1) loamy fine sand; weak fine subangular blocky structure parting to weak very fine granular; very friable; strong effervescence; moderately alkaline; clear smooth boundary.

Bk—12 to 20 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; common fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; strong effervescence; moderately alkaline; clear smooth boundary.

C1—20 to 32 inches; light brownish gray (2.5Y 6/2) fine sand; common fine prominent yellowish brown (10YR 5/6) and olive yellow (2.5Y 6/6 and 6/8) mottles; single grain; loose; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—32 to 60 inches; light gray (2.5Y 6/1) sand; many fine prominent yellowish brown (10YR 5/8) and dark brown (7.5YR 3/4) mottles; single grain; loose; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 10 to 24 inches in thickness. A slight accumulation of free carbonates commonly is in the A horizon, the Bk horizon, or both, but the maximum content is less than 15 percent. Reaction is mildly alkaline or moderately alkaline throughout the profile. The soils typically do not have coarse fragments.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It may have mottles in some parts. It is loamy sand, fine sand, sand, loamy fine sand, sandy loam, or fine sandy loam. The coarser textures commonly are only in the lower part of the horizon. The layers of sandy loam or fine sandy loam are typically less than 9 inches thick. The Bk and C horizons have hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 3. They have few to many mottles. They are fine sand or sand.

Foxhome Series

The Foxhome series consists of moderately well drained, moderately permeable soils on glacial lake plains. These soils formed in sandy and gravelly, water-sorted sediments over calcareous, loamy glacial till or lacustrine sediments. Slopes range from 1 to 3 percent.

Typical pedon of Foxhome sandy loam, 900 feet north and 2,500 feet west of the southeast corner of sec. 2, T. 133 N., R. 46 W.

A—0 to 14 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; about 5 percent gravel; neutral; clear smooth boundary.

Bw—14 to 18 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine subangular blocky structure; very friable; about 7 percent gravel; neutral; clear smooth boundary.

2BC—18 to 25 inches; brown (10YR 4/3) very gravelly sand; single grain; loose; about 35 percent gravel; neutral; clear smooth boundary.

2C—25 to 30 inches; yellowish brown (10YR 5/4) very gravelly coarse sand; few fine distinct grayish brown (10YR 5/2) mottles; single grain; loose; about 45 percent gravel; slight effervescence; mildly alkaline; abrupt smooth boundary.

3C—30 to 60 inches; light olive gray (5Y 6/2) silt loam; common medium prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; friable; about 4 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of solum and the depth to free carbonates range from 15 to 30 inches. The mollic epipedon is 10 to 16 inches thick. The content of coarse fragments is less than 15 percent in the A, B, and 3C horizons and ranges from 35 to 75 percent the 2B and 2C horizons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is sandy loam, fine sandy loam, or loam. The B horizon has value of 3 or 4 and chroma of 2 or 3. It is loamy sand, sandy loam, or loam. The 2C and 3C horizons are mildly alkaline or moderately alkaline. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is very gravelly sand or very gravelly coarse sand. The 3C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 or 3. It is typically silt loam, loam, or clay loam, but sandy loam, fine sandy loam, and silty clay loam are within the range.

Galchutt Series

The Galchutt series consists of somewhat poorly drained soils on lake plains. These soils formed dominantly in silty lacustrine material and in the underlying clayey sediments. Permeability is moderate in the upper part of the profile and slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Galchutt silt loam, 560 feet east and 2,620 feet south of the northwest corner of sec. 21, T. 132 N., R. 47 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.

E—10 to 13 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; few fine distinct brown (10YR 5/3) and yellowish brown (10YR 5/6) mottles; weak very thin platy structure parting to weak very fine subangular blocky; friable; neutral; clear broken boundary.

2Bt1—13 to 16 inches; dark grayish brown (2.5Y 4/2) clay; common fine prominent dark reddish brown (5YR 3/4) and reddish brown (5YR 4/4) mottles; strong medium angular blocky structure; very firm; very dark gray (10YR 3/1) coatings on faces of peds; neutral; clear smooth boundary.

2Bt2—16 to 23 inches; dark grayish brown (2.5Y 4/2) clay; few fine prominent yellowish red (5YR 5/6 and 5/8) mottles; strong fine and medium angular blocky structure; very firm; very dark grayish brown (10YR 3/2) coatings on faces of peds; neutral; clear smooth boundary.

2BC—23 to 36 inches; olive brown (2.5Y 4/4) clay; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; firm; slight effervescence; mildly alkaline; gradual smooth boundary.

2C—36 to 60 inches; olive brown (2.5Y 4/4) silty clay; common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The depth to free carbonates ranges from 19 to 48 inches. The thickness of the silty sediments ranges from 13 to 40 inches.

The Ap or A horizon has value of 2 or 3. In some pedons it has faint mottles in the lower part. It is silt loam, loam, or silty clay loam. The E horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 3. It is very fine sandy loam, silt loam, or loam. It is discontinuous and mixed with the Ap horizon in many pedons. The 2Bt and 2C horizons are silty clay or clay. The 2Bt horizon has value of 4 or 5 and chroma of 2 or 3. It is neutral or mildly alkaline. The 2C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 to 4. It has distinct or prominent mottles in some pedons. In some pedons it has few or common soft accumulations of lime.

Glyndon Series

The Glyndon series consists of somewhat poorly drained and moderately well drained, moderately permeable or moderately rapidly permeable soils in lake basins. These soils formed in silty lacustrine material high in content of very fine sand. Slopes range from 0 to 2 percent.

Typical pedon of Glyndon very fine sandy loam, 780 feet west and 370 feet north of the southeast corner of sec. 33, T. 131 N., R. 45 W.

Ap—0 to 9 inches; black (10YR 2/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine granular; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak—9 to 13 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; violent effervescence; strongly alkaline; clear smooth boundary.

Bk—13 to 23 inches; dark gray (10YR 4/1) sandy clay loam; weak fine and medium subangular blocky structure; very friable; violent effervescence; moderately alkaline; clear wavy boundary.

C1—23 to 39 inches; light olive brown (2.5Y 5/4) very fine sandy loam; few fine faint light olive brown (2.5Y 5/6) mottles; weak very fine subangular blocky structure; very friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—39 to 60 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; common fine and medium distinct olive yellow (2.5Y 6/6 and 6/8) mottles; few fine prominent strong brown (7.5YR 5/8) mottles; weak very fine subangular blocky structure; very friable; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The calcic horizon is within 16 inches of the surface.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically very fine sandy loam or silty clay loam, but the range includes loam, silt loam, and sandy clay loam. This horizon is mildly alkaline to strongly alkaline. Some pedons do not have an Ak horizon. The Bk horizon has value of 4 to 6 and chroma of 1 to 3. It is mottled in some pedons. It is loam, silt loam, silty clay loam, sandy clay loam, very fine sand, or very fine sandy loam. It is mildly alkaline to strongly alkaline. The C horizon has hue of 2.5Y or 5Y and value of 5 or 6. It has chroma of 3 or 4 in the upper part and chroma of 2 to 4 in the lower part. It is very fine sandy loam, very fine sand, or loamy very fine sand.

Grimstad Series

The Grimstad series consists of somewhat poorly drained and moderately well drained soils on lake plains. These soils formed in sandy material over silty and loamy glacial till or lacustrine deposits. Permeability is rapid in the subsoil and moderate in the underlying material. Slopes range from 0 to 2 percent.

Typical pedon of Grimstad sandy loam, 2,600 feet west and 100 feet north of the southeast corner of sec. 13, T. 136 N., R. 46 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; few fine bleached sand grains; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk1—10 to 18 inches; dark gray (10YR 4/1) sandy loam; weak medium subangular blocky structure; friable; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—18 to 23 inches; dark brown (10YR 4/3) loamy fine sand; weak fine granular structure; very friable; strong effervescence; mildly alkaline; clear smooth boundary.

C—23 to 32 inches; light yellowish brown (2.5Y 6/4) fine sand; few fine distinct brownish yellow (10YR 6/8) mottles; single grain; loose; discontinuous pebble band at the bottom of the horizon; slight effervescence; mildly alkaline; abrupt smooth boundary.

2C—32 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; many medium distinct yellowish brown (10YR 5/6 and 5/8) and few fine and medium prominent strong brown (7.5YR 5/8) mottles; massive; firm; few black (10YR 2/1) concretions of iron; about 5 percent coarse fragments; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The top of the calcic horizon is within 16 inches of the surface. The depth to the 2C horizon ranges from 20 to 40 inches. Free carbonates are throughout the profile. Reaction is mildly alkaline or moderately alkaline in the surface layer and mildly alkaline to strongly alkaline in the underlying material. Some pedons do not have a thin pebble band at the contact point of the upper sediments and the 2C horizon.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically sandy loam, but the range includes loamy fine sand, loamy very fine sand, fine sandy loam, and loam. Some pedons have an Ak horizon. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is loamy sand, sandy loam, or loamy fine sand. It has a calcium carbonate equivalent of 5 to 20 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It commonly is mottled in most parts, but it does not have distinct or prominent mottles within a depth of 20 inches. It is sand, fine sand, loamy sand, or loamy very fine sand. The 2C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 2 to 4. It commonly has distinct or prominent mottles. It is loam, silt loam, fine sandy loam, clay loam, or silty clay loam.

Hamerly Series

The Hamerly series consists of somewhat poorly drained and moderately well drained, moderately permeable soils on uplands. These soils formed in lake-washed till. Slopes range from 0 to 4 percent.

Typical pedon of Hamerly clay loam, 0 to 2 percent slopes, 1,050 feet north and 200 feet west of the southeast corner of sec. 18, T. 130 N., R. 46 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bk1—9 to 15 inches; grayish brown (2.5Y 5/2) clay loam; few medium light gray (2.5Y 7/2) pockets of gypsum crystals; moderate medium subangular blocky structure; friable; about 2 percent coarse fragments; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—15 to 25 inches; light olive brown (2.5Y 5/4) clay loam; many medium light gray (2.5Y 7/2) pockets of gypsum crystals; weak fine subangular structure; very friable; common medium soft white (5Y 8/1) masses of calcium carbonate; about 2 percent coarse fragments; very strong effervescence; moderately alkaline; clear smooth boundary.

C1—25 to 32 inches; olive gray (5Y 4/2) clay loam; common medium distinct light olive brown (2.5Y 5/4 and 5/6) mottles; common medium light gray (2.5Y 7/2) pockets of gypsum crystals; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—32 to 60 inches; olive gray (5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/8) and reddish brown (2.5YR 5/4) mottles; common medium light gray (2.5Y 7/2) pockets of gypsum crystals; massive; firm; about 2 percent coarse fragments; slight effervescence; mildly alkaline.

The content of coarse fragments is 1 to 10 percent throughout the profile. The Ap or A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is commonly clay loam or loam, but in some pedons it is silt loam or silty clay loam. It typically is mildly alkaline or moderately alkaline, but it ranges from neutral to moderately alkaline. Some pedons have an Ak horizon. The thickness of the A horizon ranges from 6 to 18 inches. The Bk and C horizons have pockets of gypsum crystals and shale fragments in most pedons. They are loam or clay loam. The Bk horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 to 4. In some pedons it has few, faint to prominent mottles. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 2 to 4. It has few to many, faint to prominent mottles.

Hantho Series

The Hantho series consists of moderately well drained, moderately permeable soils on lake plains. These soils formed in silty, water-sorted glacial material. Slopes range from 0 to 3 percent.

The Hantho soils in Wilkin County contain slightly more clay than is definitive for the series. This difference, however, does not significantly affect the use and management of the soils.

Typical pedon of Hantho silt loam, 250 feet east and 75 feet north of the southwest corner of sec. 2, T. 136 N., R. 45 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.

A—9 to 18 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

Bw1—18 to 24 inches; very dark grayish brown (10YR 3/2) silt loam; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bw2—24 to 32 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

C1—32 to 37 inches; olive brown (2.5Y 4/4) silt loam; few fine faint light yellowish brown (10YR 6/4) mottles; weak fine subangular blocky structure; very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C2—37 to 50 inches; light olive brown (2.5Y 5/4) silt loam; few fine distinct light yellowish brown (10YR 6/4) mottles; massive; very friable; strong effervescence; moderately alkaline; clear smooth boundary.

C3—50 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; many medium prominent yellowish brown (10YR 5/6 and 5/8) and few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum ranges from 18 to 32 inches in thickness. It is very fine sandy loam or silt loam. The mollic epipedon is 16 to 24 inches thick.

The Ap and A horizons have value of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 or 3. In some pedons it has faint, grayish or brownish mottles. The C horizon has value of 4 to 6 and chroma of 2 to 6. It is silt loam, very fine sandy loam, or silty clay loam. The control section has few to many mottles.

Haug Series

The Haug series consists of very poorly drained, moderately permeable soils on lake plains and ground moraines. These soils formed in a thin layer of organic material and in the underlying calcareous, silty glacial till. Slopes are less than 1 percent.

Typical pedon of Haug muck, 1,050 feet east and 700 feet north of the southwest corner of sec. 19, T. 135 N., R. 46 W.

Oa—0 to 14 inches; black (10YR 2/1) muck; weak very fine granular structure; very friable; slight effervescence; mildly alkaline; about 20 percent fiber unrubbed and 2 percent rubbed; gradual smooth boundary.

A—14 to 20 inches; very dark gray (5Y 3/1) loam; weak very fine granular structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Cg—20 to 60 inches; gray (5Y 5/1) silt loam; common medium and coarse prominent brownish yellow (10YR 6/6) and light olive brown (2.5Y 5/6) mottles; massive; sticky; strong effervescence; mildly alkaline.

The histic epipedon is 8 to 16 inches thick. Free carbonates are within 10 inches of the top of the A horizon. The content of coarse fragments in the mineral soil material is 0 to 10 percent.

The O horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly sapric material, but in some pedons it has layers of hemic material. It is neutral or mildly alkaline. It has weak or moderate structure. The A and Cg horizons are mildly alkaline or moderately alkaline. The A horizon has hue of 10YR to 5Y and value of 2 or 3. It is dominantly sandy loam, fine sandy loam, sandy clay loam, loam, or silt loam. In some pedons, however, it is mucky. A few cobbles and other coarse fragments are at the top of this horizon in some pedons. The Cg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 or 2. It is sandy loam, fine sandy loam, sandy clay loam, loam, or silt loam. The content of coarse fragments in this horizon is 0 to 3 percent.

Hilaire Series

The Hilaire series consists of moderately well drained soils on lake plains. These soils formed dominantly in sandy lacustrine sediments over clayey glacial till or glaciolacustrine sediments. Permeability is rapid in the upper part of the profile and slow in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Hilaire loamy fine sand, 75 feet west and 1,780 feet south of the northeast corner of sec. 34, T. 135 N., R. 47 W.

A—0 to 10 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; few fine bleached sand grains; neutral; clear smooth boundary.

Bw—10 to 16 inches; brown (10YR 4/3) loamy sand; few fine faint yellowish brown relict mottles; single grain; loose; neutral; gradual smooth boundary.

C—16 to 26 inches; pale brown (10YR 6/3) loamy sand; common fine and medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; single grain; loose; neutral; abrupt smooth boundary.

2Cg—26 to 60 inches; olive gray (5Y 5/2) silty clay; common fine prominent dark yellowish brown (10YR 4/6) and light olive brown (2.5Y 5/6) mottles; light gray (2.5Y 7/2) lime nodules; weak very fine subangular blocky structure; sticky; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 12 to 36 inches. The mollic epipedon is 7 to 16 inches thick. The depth to free carbonates ranges from 16 to 40 inches. The thickness of the sandy sediments ranges from 20 to 40 inches. The content of coarse fragments ranges from 0 to 15 percent in the sandy sediments and from 0 to 10 percent in the clayey material. Some pedons have a stone line as much as 6 inches thick at the contact point of the two sediments. The content of coarse fragments is as much as 35 percent in the stone line.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loamy sand, loamy fine sand, sandy loam, or fine sandy loam. The B and C horizons are sand, fine sand, loamy sand, or loamy fine sand. The B horizon has value of 3 or 4 and chroma of 2 to 4. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. The C and 2C horizons are mildly alkaline or moderately alkaline. The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2, or it is neutral in hue and has value of 3 or 4 and chroma of 0. It has few to many mottles. It is clay, silty clay, or silty clay loam.

Kittson Series

The Kittson series consists of somewhat poorly drained and moderately well drained, moderately slowly permeable or moderately permeable soils on lake plains and moraines. These soils formed in calcareous, loamy glacial till. Slopes range from 0 to 2 percent.

Typical pedon of Kittson loam, 1,500 feet south and 1,230 feet west of the northeast corner of sec. 27, T. 130 N., R. 48 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A—8 to 14 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bw—14 to 18 inches; dark grayish brown (10YR 4/2) loam; weak medium subangular blocky structure; friable; slight effervescence; mildly alkaline; clear wavy boundary.

2C1—18 to 32 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; discontinuous gravel band at the top of the horizon; strong effervescence; moderately alkaline; gradual wavy boundary.

2C2—32 to 60 inches; grayish brown (2.5Y 5/2) clay loam; many coarse distinct dark grayish brown (2.5Y

4/2) and many medium prominent yellowish brown (10YR 5/8) mottles; massive; firm; about 2 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 14 to 30 inches. The mollic epipedon is 9 to 16 inches thick. The content of coarse fragments in the till material is 2 to 10 percent. The solum is neutral or mildly alkaline.

The A and Ap horizons have value of 2 or 3 and chroma of 1 or 2. They typically are loam, but the range includes sandy loam, fine sandy loam, very fine sandy loam, and sandy clay loam. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or 3. In some pedons it is mottled in the lower part. It typically is loam, but in some pedons it is sandy loam, fine sandy loam, very fine sandy loam, or sandy clay loam or has thin strata of loamy sand or coarser textured material. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loam or clay loam. It is mildly alkaline or moderately alkaline.

Lamoure Series

The Lamoure series consists of poorly drained, moderately permeable soils on flood plains. These soils formed in silty alluvial deposits. Slopes are less than 2 percent.

Typical pedon of Lamoure silty clay loam, occasionally flooded, 550 feet south and 220 feet west of the northeast corner of sec. 11, T. 136 N., R. 47 W.

A1—0 to 18 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable, slightly sticky; slight effervescence; moderately alkaline; gradual smooth boundary.

A2—18 to 32 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable, slightly sticky; slight effervescence; moderately alkaline; clear smooth boundary.

Cg1—32 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam; weak very fine subangular blocky structure; friable, sticky; few medium very dark gray (2.5Y 3/1) blotches and streaks; strong effervescence; moderately alkaline; clear smooth boundary.

Cg2—40 to 48 inches; gray (2.5Y 5/1) silt loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine horizontal laminations; friable; strong effervescence; moderately alkaline; clear wavy boundary.

Cg3—48 to 60 inches; dark gray (2.5Y 4/1) and gray (2.5Y 5/1), stratified silt loam and very fine sand; few fine prominent yellowish brown (10YR 5/8) mottles; massive; slightly sticky; very dark gray (2.5Y 3/1) blotches; slight or strong effervescence; moderately alkaline.

The mollic epipedon and the solum range from 24 to 42 inches in thickness. In some pedons a buried A horizon is below a depth of 30 inches. The depth to free carbonates ranges from 0 to 10 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 2 or less. It is silty clay loam or silt loam. The Cg horizon has hue of 2.5Y or 5Y or is neutral in hue. It has value of 3 to 5 and chroma of 2 or less. In some pedons it has soft masses of carbonate. In some pedons it has strata of loam, silt loam, sandy loam, silty clay loam, sand, gravelly sand, or loamy sand below a depth of 40 inches.

Langhei Series

The Langhei series consists of well drained, moderately permeable soils on moraines. These soils formed in loamy, calcareous glacial till. Slopes range from 2 to 18 percent.

Typical pedon of Langhei loam, in an area of Barnes-Langhei loams, 2 to 6 percent slopes, eroded; 2,460 feet north and 2,260 feet east of the southwest corner of sec. 11, T. 134 N., R. 45 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak very fine subangular blocky structure; very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 34 inches; light olive brown (2.5Y 5/4) loam; weak fine subangular blocky structure; very friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—34 to 60 inches; light olive brown (2.5Y 5/4) loam; few fine distinct brownish yellow (10YR 6/8) mottles; massive; very friable; about 5 percent coarse fragments; strong effervescence; mildly alkaline.

The content of coarse fragments is typically 2 to 10 percent throughout the profile. The control section is generally loam throughout, but in some pedons it is clay loam. Some pedons have coarser textured horizons as much as 10 inches thick.

The Ap horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. Pedons in uncultivated areas have an A horizon. This horizon is 2 to 4 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is neutral to moderately alkaline. The C horizon has hue of 2.5Y or 10YR, value of 4 to 7, and chroma of 2 to 4. It has few to many, faint to prominent mottles. The calcium carbonate equivalent in this horizon ranges from 15 to 35 percent.

Lindaas Series

The Lindaas series consists of poorly drained, slowly permeable soils in depressions on lake plains. These soils formed in calcareous lacustrine sediments. Slopes are less than 1 percent.

Typical pedon of Lindaas silt loam, 900 feet west and 2,010 feet north of the southeast corner of sec. 21, T. 135 N., R. 47 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; about 1 percent coarse fragments; neutral; abrupt smooth boundary.

Btg1—9 to 22 inches; very dark gray (2.5Y 3/1) clay; common fine distinct yellowish brown (10YR 5/8) mottles; weak very fine subangular blocky structure; very sticky; neutral; gradual smooth boundary.

Btg2—22 to 27 inches; dark gray (2.5Y 4/1) clay; common fine distinct yellowish brown (10YR 5/8) mottles; moderate fine prismatic structure parting to moderate fine and medium angular blocky; very sticky; organic stains and clay films on faces of blocks; neutral; gradual wavy boundary.

Cg1—27 to 38 inches; olive gray (5Y 5/2) silty clay loam; common fine and medium prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak very fine subangular blocky structure; very friable; about 1 percent shale fragments and lime concretions; moderately alkaline; strong effervescence; gradual smooth boundary.

Cg2—38 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine and medium prominent brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) mottles; moderate thin platy structure parting to moderate fine angular blocky; friable; some varves; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 35 inches. The depth to free carbonates ranges from 20 to 35 inches. Coarse fragments generally are throughout the profile or in some parts of the profile, but some pedons have no coarse fragments.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam, clay loam, or silty clay loam. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is silty clay or clay. In some pedons it has clean sand grains and silt coatings on faces of peds. The lower part of this horizon has free carbonates, distinct mottles, or both in some pedons. The Cg horizon has hue of 2.5Y or 5Y, value of 5 to 7, and chroma of 1 to 4. It is dominantly silt loam, clay loam, or silty clay loam, but in some pedons it is silty clay below a depth of 40 inches.

Lohnes Series

The Lohnes series consists of moderately well drained and well drained, rapidly permeable soils on lake plains and outwash plains. These soils formed in calcareous, sandy and gravelly sediments. Slopes range from 0 to 6 percent.

Typical pedon of Lohnes loamy sand, 1 to 6 percent slopes, 105 feet west and 1,810 feet south of the northeast corner of sec. 5, T. 136 N., R. 45 W.

A—0 to 10 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak very fine granular structure; very friable and loose; some bleached sand grains; neutral; abrupt smooth boundary.

AB—10 to 16 inches; very dark grayish brown (10YR 3/2) loamy coarse sand, dark brown (10YR 4/3) dry; single grain; loose; neutral; clear smooth boundary.

Bw—16 to 22 inches; brown (10YR 4/3) loamy sand; single grain; loose; about 5 percent coarse fragments; neutral; clear smooth boundary.

C1—22 to 34 inches; light olive brown (2.5Y 5/4) gravelly loamy sand; single grain; loose; about 15 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—34 to 60 inches; light olive brown (2.5Y 5/4) gravelly coarse sand; single grain; loose; about 15 percent coarse fragments; strong effervescence; mildly alkaline.

The mollic epipedon ranges from 10 to 20 inches in thickness. In some pedons the content of gravel averages as much as 35 percent in these soils. Reaction is neutral to moderately alkaline throughout the profile.

The A horizon has value of 2 or 3. It is sand, loamy coarse sand, loamy sand, coarse sandy loam, or sandy loam. The B horizon has value of 2 to 4 and chroma of 1 to 3. It is loamy sand, loamy coarse sand, or gravelly loamy sand. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 2 to 4. It has few or common mottles in some pedons.

McIntosh Series

The McIntosh series consists of somewhat poorly drained and moderately well drained soils on ground moraines. These soils formed in silty lacustrine sediments over loamy glacial till. Permeability is moderate in the upper part of the profile and moderate or moderately slow in the lower part. Slopes range from 0 to 3 percent.

Typical pedon of McIntosh silt loam, 1,300 feet south and 800 feet east of the northwest corner of sec. 33, T. 136 N., R. 45 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

Ak—7 to 12 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; few fine soft white (5Y 8/1) masses of calcium carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

Bk—12 to 25 inches; dark gray (10YR 4/1) silt loam; moderate medium subangular blocky structure; common medium soft white (5Y 8/1) masses of calcium carbonate; very friable; violent effervescence; moderately alkaline; clear smooth boundary.

2C1—25 to 29 inches; light olive brown (2.5Y 5/4) clay loam; few fine distinct brownish yellow (10YR 6/8) and common fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; about 3 percent coarse fragments; violent effervescence; mildly alkaline; gradual smooth boundary.

2C2—29 to 60 inches; light olive brown (2.5Y 5/4) clay loam; few fine prominent yellowish red (5YR 5/6) and common fine and medium distinct yellowish brown (10YR 5/6 and 5/8) mottles; massive; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The depth to glacial till ranges from 24 to 40 inches. Free carbonates are throughout the profile. The calcium carbonate equivalent ranges from 20 to 35 percent. The higher color values are in the calcic horizon. The lacustrine sediments typically have no coarse fragments, but in some pedons the content of these fragments is as much as 3 percent. The content of coarse fragments in the glacial till is 2 to 10 percent.

The A and Bk horizons are silt loam, silty clay loam, or loam. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The Bk horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 to 4. It has no distinct or prominent mottles. The 2C horizon has value of 5 or 6 and chroma of 3 to 6. In some pedons it is not mottled. It is loam or clay loam.

Northcote Series

The Northcote series consists of poorly drained, slowly permeable soils on lake plains. These soils formed in calcareous, clayey lacustrine sediments. Slopes are 0 to 1 percent.

Typical pedon of Northcote clay, 80 feet east and 170 feet north of the southwest corner of sec. 17, T. 134 N., R. 47 W.

Ap—0 to 9 inches; black (10YR 2/1) clay, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; extremely firm; neutral; abrupt smooth boundary.

Bg1—9 to 16 inches; very dark gray (5Y 3/1) clay, dark gray (5Y 4/1) dry; moderate medium subangular blocky structure; very firm; very dark gray (5YR 3/1) films on faces of peds; neutral; clear wavy boundary.

Bg2—16 to 20 inches; dark olive gray (5Y 3/2) clay, dark gray (5Y 4/1) dry; moderate fine subangular blocky structure; firm; few soft lime nodules; slight effervescence; dark olive gray (5Y 3/2) films on faces of peds; mildly alkaline; abrupt wavy boundary.

Cg1—20 to 37 inches; dark gray (5Y 4/1) clay; moderate very fine angular blocky structure; firm; few soft lime nodules; strong effervescence; dark olive gray (5Y 3/2) films on faces of peds; moderately alkaline; gradual smooth boundary.

Cg2—37 to 60 inches; olive gray (5Y 4/2) clay; common fine faint olive (5Y 5/3) mottles; weak fine angular blocky structure; firm; slight effervescence; dark olive gray (5Y 3/2) films on faces of peds; mildly alkaline.

The thickness of the solum ranges from 16 to 36 inches. Tongues of material from the A horizon extend to a depth of 48 inches in some pedons. The depth to free carbonates ranges from 12 to 30 inches.

The A horizon is 6 to 20 inches thick. It has hue of 10YR or 2.5Y, value of 2, and chroma of 1, or it is neutral in hue and has value of 2 and chroma of 0. The B horizon has hue of 2.5Y or 5Y, value of 3 or 4, and chroma of 1 or 2. It is mottled in some pedons. It is neutral or mildly alkaline. The C horizon has value of 4 or 5 and chroma of 1 or 2. It is mottled in at least some layers within a depth of 40 inches. It has masses of gypsum crystals in some pedons. It is mildly alkaline or moderately alkaline.

Osakis Series

The Osakis series consists of moderately well drained soils on outwash plains. These soils formed in loamy material over sandy material. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Slopes range from 1 to 3 percent.

Typical pedon of Osakis sandy loam, 1,350 feet south and 200 feet west of the northeast corner of sec. 33, T. 136 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

AB—8 to 15 inches; very dark brown (10YR 2/2) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; neutral; clear smooth boundary.

Bw—15 to 19 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; very friable; neutral; clear smooth boundary.

2BC—19 to 24 inches; brown (10YR 4/3) loamy sand; massive; loose; about 10 percent coarse fragments; neutral; clear wavy boundary.

2C1—24 to 40 inches; dark grayish brown (2.5Y 4/2) very gravelly loamy sand; few medium distinct yellowish brown (10YR 5/6) mottles; massive; loose; about 50 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

2C2—40 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly sand; many medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; massive; loose; about 20 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates are 16 to 25 inches. The depth to sandy material is 12 to 20 inches. The content of coarse fragments ranges from 10 to 65 percent in the sandy sediments. The solum is neutral or slightly acid.

The A or Ap horizon has value of 2 or 3. It is loam, sandy clay loam, or sandy loam. The Bw horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 to 4. In some pedons it is mottled in the lower part. It is loam or sandy loam. Some pedons do not have a 2BC horizon. The 2C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 2 or 3. It has few to many, faint to prominent mottles.

Parnell Series

The Parnell series consists of very poorly drained, slowly permeable soils in depressions on ground moraines. These soils formed in silty and clayey, water-sorted sediments. Slopes are typically less than 1 percent.

Typical pedon of Parnell silt loam, 1,580 feet south and 1,930 feet west of the northeast corner of sec. 23, T. 135 N., R. 45 W.

A—0 to 20 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.

E—20 to 24 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; weak very fine granular structure; very friable; neutral; clear smooth boundary.

Btg1—24 to 36 inches; very dark grayish brown (10YR 3/2) silty clay; common fine prominent yellow (10YR 7/8), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; sticky; very dark brown (10YR 2/2) coatings on faces of peds; neutral; gradual smooth boundary.

Btg2—36 to 60 inches; grayish brown (2.5Y 5/2) silty clay; common fine prominent dark yellowish brown (10YR 4/6) and strong brown (7.5YR 5/6 and 5/8) mottles; moderate medium prismatic structure parting to moderate very fine angular blocky; sticky; very dark grayish brown (2.5Y 3/2) coatings on faces of peds; neutral.

The thickness of the mollic epipedon ranges from 24 to 65 inches. The depth to free carbonates ranges from about 35 to 80 inches. The A horizon typically has no coarse fragments. In some pedons the content of these fragments is as much as 8 percent in the lower part of the B horizon.

The A horizon has hue of 10YR, 2.5Y, or 5Y, value of 2, and chroma of 1, or it is neutral in hue and has value of 2 and chroma of 0. It is loam, silt loam, silty clay, or silty clay loam. It is slightly acid to mildly alkaline. Some pedons do not have an E horizon. The Bt horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 to 4, and chroma of 1 or 2. It commonly is mottled throughout. It is silty clay, silty clay loam, clay loam, or clay. It commonly has clay films with value of 2 or 3. It ranges from slightly acid in the upper part to mildly alkaline in the lower part. Some pedons have a C horizon. This horizon has hue of 2.5Y or 5Y, value of 3 to 6, and chroma of 1 or 2. It is loam, clay loam, silty clay loam, silty clay, or clay.

Perella Series

The Perella series consists of somewhat poorly drained, slowly permeable or moderately slowly permeable soils in glacial lake basins. These soils formed in calcareous lacustrine sediments. Slopes are 0 to 1 percent.

Typical pedon of Perella silty clay, 140 feet south and 730 feet west of the northeast corner of sec. 28, T. 133 N., R. 47 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; sticky; neutral; abrupt smooth boundary.

Bg—9 to 19 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (10YR 5/2) dry; few very dark brown coatings on peds; moderate fine subangular blocky structure; very sticky; cracks filled with material from the A horizon extend into this horizon; neutral; clear smooth boundary.

Cg1—19 to 26 inches; grayish brown (2.5Y 5/2) silty clay loam and silt loam; weak very fine subangular blocky structure; friable, strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—26 to 32 inches; grayish brown (2.5Y 5/2) silt loam; many fine distinct light olive brown (2.5Y 5/4 and 5/6) mottles; weak medium subangular blocky structure; friable; about 1 percent coarse fragments;

strong effervescence; moderately alkaline; clear smooth boundary.

Cg3—32 to 60 inches; grayish brown (2.5Y 5/2), laminated silt loam and silty clay loam; common fine distinct olive brown (2.5Y 4/4) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates are 16 to 24 inches. The mollic epipedon is about 10 to 20 inches thick.

The Ap horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 1 or 2 and chroma of 0 or 1. It is clay or silty clay. Some pedons have an A horizon or A1 and A2 horizons. In some pedons tongues of material from the A horizon extend into the upper part of the 2C horizon. The Bg horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 2 to 4 and chroma of 0 to 3. It is mottled in some pedons. It is clay or silty clay. In some pedons it has slickensides and shiny, waxy surfaces on peds. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 4. It is silt, silt loam, or silty clay loam. It has crystals of gypsum and other soluble salts in some pedons. Coarser or finer textured sediments are below a depth of 40 inches in some pedons.

Quam Series

The Quam series consists of very poorly drained, moderately slowly permeable soils in depressions and drainageways on ground moraines. These soils formed in noncalcareous, silty and loamy colluvial deposits and in the underlying silty, calcareous glacial till. Slopes are 0 to 1 percent.

Typical pedon of Quam silt loam, 1,540 feet west and 1,050 feet south of the northeast corner of sec. 23, T. 135 N., R. 45 W.

A1—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; neutral; clear smooth boundary.

A2—10 to 19 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; common fine distinct strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A3—19 to 32 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; weak very fine subangular blocky structure; sticky; about 2 percent coarse fragments; neutral; clear smooth boundary.

2Cg1—32 to 47 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak very fine subangular blocky structure; very friable; about 2 percent coarse fragments; violent effervescence; moderately alkaline; clear smooth boundary.

2Cg2—47 to 60 inches; olive gray (5Y 5/2) silt loam; common fine and medium prominent dark yellowish brown (10YR 4/6) and brownish yellow (10YR 6/6) mottles; weak very fine subangular blocky structure; very friable; about 2 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon is typically 30 to 60 inches but ranges from 24 to 80 inches. The depth to free carbonates ranges from 30 to 70 inches.

The A horizon has hue of 10YR, 2.5Y, or 5Y and chroma of 1, or it is neutral in hue and has chroma of 0. It has value of 2 in the upper part and value of 2 or 3 in the lower part. It is not mottled in some pedons. It is silty clay loam, clay loam, or silt loam. The 2Cg horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It commonly has distinct or prominent mottles, but in some pedons it has no mottles. It is loam, silt loam, silty clay loam, or clay loam.

Rockwell Series

The Rockwell series consists of poorly drained and very poorly drained soils on lake plains. These soils formed in loamy and sandy material over glacial or lacustrine deposits. Permeability is moderately rapid or rapid in the upper part of the profile and moderate or moderately slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Rockwell loam, 1,500 feet east and 50 feet south of the northwest corner of sec. 5, T. 134 N., R. 46 W.

A—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bk—10 to 16 inches; gray (N 6/0) loam; weak very fine granular structure; friable; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; abrupt smooth boundary.

C1—16 to 19 inches; olive gray (5Y 5/2) fine sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure parting to weak very fine granular; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C2—19 to 24 inches; light olive gray (5Y 6/2) fine sand; common medium prominent yellowish brown (10YR 5/6) and few fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; weak fine granular structure parting to single grain; very friable; mildly alkaline; abrupt smooth boundary.

2C—24 to 60 inches; olive gray (5Y 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/8) and few fine prominent brownish yellow (10YR 6/8) mottles; weak fine subangular blocky structure parting to weak very fine granular; friable; few fine prominent black (10YR 2/1) masses of iron; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 7 to 18 inches in thickness. The top of the calcic horizon is within 16 inches of the surface. The depth to the 2C horizon ranges from 20 to 40 inches. Reaction is mildly alkaline or moderately alkaline in the A horizon and mildly alkaline to strongly alkaline in the C horizon. Effervescence is slight to violent in the A horizon, strong or violent in the Bk horizon, and slight or strong in the C horizon.

The A horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It is sandy loam, fine sandy loam, loam, or sandy clay loam. Some pedons have an Ak horizon. The Bk horizon has hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 1 or 2, or it is neutral in hue and has value of 4 to 6 and chroma of 0. It is mottled in some pedons. It is sandy loam, fine sandy loam, or loam. Parts of the A and Bk horizons are mixed in some pedons. The C horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It has distinct and prominent mottles in most parts. It is sand, fine sand, loamy sand, fine sandy loam, or loamy fine sand. The 2C horizon has matrix colors and mottles similar to those of the C horizon. It is loam, silt loam, sandy loam, fine sandy loam, very fine sandy loam, clay loam, or silty clay loam.

Roliss Series

The Roliss series consists of poorly drained, moderately permeable or moderately slowly permeable soils on lake plains. These soils formed in calcareous, loamy glacial till. Slopes are 0 to 1 percent.

Typical pedon of Roliss clay loam, 300 feet north and 2,460 feet west of the southeast corner of sec. 15, T. 132 N., R. 45 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine granular; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

Bg—10 to 17 inches; olive gray (5Y 4/2) clay loam; few fine distinct brownish yellow (10YR 6/8) mottles; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; small, discontinuous stone line at the base of the horizon; slight effervescence; mildly alkaline; clear wavy boundary.

2Cg1—17 to 26 inches; gray (5Y 5/1) clay loam; few fine prominent brownish yellow (10YR 6/6) mottles; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

2Cg2—26 to 60 inches; olive gray (5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) and common fine prominent yellowish brown (10YR 5/8) mottles; massive; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 7 to 18 inches. The content of coarse fragments generally ranges from 2 to 20 percent. In some pedons, however, the A and B horizons have no coarse fragments.

The A horizon is black (10YR 2/1 or N 2/0). It is mottled in some pedons. It is typically loam, sandy clay loam, or clay loam, but the range includes silty clay loam, silt loam, and sandy loam. Some pedons have an AB horizon. The Bg horizon has hue of 2.5Y or 5Y, value 3 to 5, and chroma of 1 or 2. It has the same textures as the A horizon. The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 4. It is loam or clay loam.

Rothsay Series

The Rothsay series consists of well drained, moderately permeable soils on lake plains and moraines. These soils formed in silty material. Slopes range from 1 to 18 percent.

Typical pedon of Rothsay silt loam, 2 to 4 percent slopes, 515 feet west and 100 feet south of the northeast corner of sec. 10, T. 136 N., R. 45 W.

A—0 to 11 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak very fine granular; friable; neutral; clear smooth boundary.

Bw—11 to 16 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; neutral; clear smooth boundary.

Bk—16 to 21 inches; pale brown (10YR 6/3) silt loam; weak very fine subangular blocky structure; very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—21 to 35 inches; yellowish brown (10YR 5/4) silt loam; weak very fine subangular blocky structure; very friable; strong effervescence; moderately alkaline; clear smooth boundary.

C2—35 to 60 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; many fine and medium prominent brownish yellow (10YR 6/6 and 6/8) and yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; very friable; few fine distinct light gray (10YR 7/1) masses of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 30 inches. The mollic epipedon is 7 to 16 inches thick. The depth to free carbonates ranges from 12 to 30 inches. The soils are silt loam or very fine sandy loam throughout.

The A horizon has value of 2 or 3. The Bw horizon has value of 3 to 5 and chroma of 2 to 4. Some pedons have a BA horizon. The Bk and C horizons have hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 2 to 5.

Seelyeville Series

The Seelyeville series consists of very poorly drained soils in depressions on outwash plains, moraines, and lake plains. These soils formed in thick deposits of organic material. Permeability is moderately slow or moderate. Slopes are typically less than 1 percent.

Typical pedon of Seelyeville muck, 2,020 feet south and 950 feet west of the northeast corner of sec. 4, T. 134 N., R. 45 W.

Oa1—0 to 4 inches; sapric material, very dark grayish brown (10YR 3/2) rubbed, dark brown (10YR 3/3) broken face; about 50 percent fiber, 15 percent rubbed; massive; herbaceous fibers and roots; neutral; clear smooth boundary.

Oa2—4 to 26 inches; black (10YR 2/1) sapric material; about 15 percent fiber, 5 percent rubbed; weak fine subangular blocky structure; very friable; primarily herbaceous fibers; slightly acid; gradual smooth boundary.

Oa3—26 to 60 inches; black (10YR 2/1) sapric material; about 20 percent fiber, 5 percent rubbed; massive; primarily herbaceous fibers; slightly acid.

The organic material extends to a depth of 51 to 100 inches. It is underlain by limnic or mineral material. The plant fibers are mostly herbaceous, but a few woody fragments are on the surface of some pedons. The organic material is generally sapric, but layers of hemic material as much as 10 inches thick are in some pedons. The control section typically ranges from very strongly acid to moderately alkaline.

The sapric material has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. In some pedons it has chroma of 3, broken face. The fiber content is typically less than 25 percent before rubbing and less than 10 percent after rubbing.

Sioux Series

The Sioux series consists of excessively drained, rapidly permeable or very rapidly permeable soils on outwash plains. These soils formed in sandy and loamy sediments in which the content of gravel is more than 35 percent. Slopes range from 1 to 6 percent.

Typical pedon of Sioux sandy loam, 1 to 6 percent slopes, 700 feet south and 75 feet east of the northwest corner of sec. 23, T. 134 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; few roots; about 5 percent coarse fragments; neutral; clear smooth boundary.

AC—8 to 11 inches; very dark grayish brown (10YR 3/2) gravelly loamy coarse sand; single grain; loose; few roots; about 30 percent gravel; neutral; clear wavy boundary.

C—11 to 60 inches; dark grayish brown (10YR 4/2) very gravelly coarse sand; single grain; loose; few roots; about 50 percent gravel; slight effervescence; moderately alkaline.

The solum is 6 to 14 inches thick. The depth to free carbonates commonly ranges from 3 to 12 inches, but some pedons are calcareous at the surface. The mollic epipedon is 7 to 14 inches thick.

The A horizon has value of 2 or 3 and chroma of less than 2. It is loam, gravelly loam, sandy loam, gravelly sandy loam, loamy sand, or gravelly loamy sand. It is neutral to moderately alkaline. The AC horizon has value of 3 or 4 and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is very gravelly loamy sand, very gravelly coarse sand, or very gravelly sand. The coarse fragments in this horizon are typically coated with calcium carbonates.

Swenoda Series

The Swenoda series consists of moderately well drained soils on uplands. These soils formed in coarse-loamy material and in the underlying loamy or silty glacial or lacustrine material. Permeability is moderately rapid in the upper part of the profile and moderate or moderately slow in the lower part. Slopes range from 1 to 4 percent.

Typical pedon of Swenoda fine sandy loam, 1 to 4 percent slopes, 880 feet west and 50 feet south of the northeast corner of sec. 1, T. 136 N., R. 45 W.

A1—0 to 13 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak very fine granular; very friable; neutral; clear smooth boundary.

A2—13 to 17 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

Bw—17 to 21 inches; dark brown (10YR 3/3) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

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2Bk—21 to 34 inches; light yellowish brown (2.5Y 6/4) silt loam; massive; very friable; few fine soft white (5Y 8/1) masses of calcium carbonate; about 5 percent coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

2C—34 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam; few fine distinct olive yellow (2.5Y 6/6) mottles; massive; very friable; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The A or Ap horizon has value of 2 or 3. It has chroma of 0 or 1 within a depth of 7 inches and chroma of 1 or 2 below that depth. It is fine sandy loam, sandy loam, loam, or loamy fine sand. It is slightly acid or neutral. The B horizon has hue of 10YR or 2.5Y and value and chroma of 2 to 4. In some pedons it has few or common, faint or distinct mottles in the lower part. It is fine sandy loam, sandy loam, loamy sand, or loamy fine sand. It is neutral or mildly alkaline. The 2Bk and 2C horizons have hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 2 to 4. They are silt loam, loam, clay loam, or silty clay loam.

Syrene Series

The Syrene series consists of poorly drained, rapidly permeable soils on lake plains. These soils formed in loamy sediments and in the underlying gravelly and sandy material. Slopes are commonly 0 to 2 percent.

Typical pedon of Syrene sandy loam, 1,760 feet north and 360 feet east of the southwest corner of sec. 23, T. 134 N., R. 45 W.

A—0 to 9 inches; black (10YR 2/1) sandy loam, gray (10YR 5/1) dry; weak very fine granular structure; very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bkg1—9 to 14 inches; dark gray (N 4/0) sandy loam; weak fine subangular blocky structure; very friable; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

Bkg2—14 to 18 inches; gray (N 5/0) sandy loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine granular structure; very friable; common medium soft white (5Y 8/1) masses of calcium carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

2Cg1—18 to 29 inches; light brownish gray (2.5Y 6/2) gravelly sand; common medium distinct light yellowish brown (10YR 6/4) mottles; single grain; loose; about 35 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

2Cg2—29 to 42 inches; olive gray (5Y 5/2) gravelly sand; common medium distinct light yellowish brown (10YR 6/4) and few fine prominent brownish yellow (10YR 6/8) mottles; single grain; loose; about 30 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

2Cg3—42 to 48 inches; light brownish gray (2.5Y 6/2) sand; many coarse prominent brownish yellow (10YR 6/6 and 6/8) and common fine prominent reddish yellow (7.5YR 6/8) mottles; single grain; loose; about 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

2Cg4—48 to 60 inches; light brownish gray (2.5Y 6/2) gravelly sand; many coarse prominent brownish yellow (10YR 6/6 and 6/8) and common fine prominent reddish yellow (7.5YR 6/8) mottles; single grain; loose; about 25 percent coarse fragments; slight effervescence; mildly alkaline.

The mollic epipedon is 8 to 16 inches thick. The calcic horizon ranges from 6 to 20 inches in thickness. The soils are mildly alkaline or moderately alkaline and have free carbonates throughout. The thickness of the loamy sediments ranges from 12 to 24 inches. The content of coarse fragments in the gravelly and sandy sediments ranges from 10 to 35 percent.

The A horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It is sandy loam, fine sandy loam, very fine sandy loam, sandy clay loam, loam, or silt loam. The content of coarse fragments in this horizon is 0 to less than 10 percent. The Bkg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2, or it is neutral in hue and has value of 4 to 6 and chroma of 0. It has a range in texture similar to that of the A horizon. The 2Cg horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. It has few to many, faint to prominent mottles. It is coarse sand, sand, fine sand, loamy coarse sand, loamy sand, or the gravelly analogs of these textures.

Ulen Series

The Ulen series consists of somewhat poorly drained and moderately well drained, rapidly permeable soils on lake plains. These soils formed in calcareous, loamy and sandy deposits. Slopes range from 0 to 2 percent.

Typical pedon of Ulen fine sandy loam, 140 feet north and 1,060 feet east of the southwest corner of sec. 25, T. 136 N., R. 46 W.

Ap—0 to 11 inches; very dark brown (10YR 2/2) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak very fine granular; very friable; common bleached sand grains; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak—11 to 16 inches; very dark grayish brown (10YR 3/2) loamy fine sand, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak very fine granular; very friable; common bleached sand grains; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

Bk—16 to 23 inches; dark grayish brown (10YR 4/2) loamy fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; common bleached sand grains; few medium soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.

C—23 to 31 inches; pale brown (10YR 6/3) fine sand; common fine distinct olive yellow (2.5Y 6/6) and yellowish brown (10YR 5/6) mottles; single grain; loose; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—31 to 38 inches; light brownish gray (10YR 6/2) fine sand; common fine distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles; single grain; loose; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg2—38 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to loamy fine sand or coarser textured material is less than 25 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loamy fine sand, loamy very fine sand, sandy loam, or fine sandy loam. The Bk horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3 or has hue of 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is loamy sand, loamy fine sand, sandy loam, or fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It has distinct or prominent mottles. It is dominantly fine sand or loamy fine sand, but some pedons have strata of very fine sand or sand.

Urness Series

The Urness series consists of very poorly drained, moderately permeable or moderately slowly permeable soils in former lakes and sloughs in lake basins. These soils formed in deposits of coprogenous earth. Slopes are less than 1 percent.

Typical pedon of Urness mucky silt loam, 30 feet south and 100 feet west of the northeast corner of sec. 4, T. 134 N., R. 45 W.

A—0 to 10 inches; black (10YR 2/1) mucky silt loam; weak fine granular structure; very friable; many fine and common medium roots; slight effervescence; mildly alkaline; clear smooth boundary.

C1—10 to 15 inches; black (N 2/0) mucky silt loam; weak fine granular structure; very friable; few fine and medium roots; few snail shell fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—15 to 25 inches; very dark gray (N 3/0) mucky silt loam; weak thin platy structure; very friable; common snail shell fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C3—25 to 34 inches; very dark gray (2.5Y 3/1) mucky silt loam; massive; very friable; common snail shell fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C4—34 to 48 inches; very dark gray (N 3/0) mucky silt loam; massive; very friable; common medium faint gray (10YR 5/1) laminations; common snail shell fragments; slight effervescence; mildly alkaline; clear smooth boundary.

2C—48 to 60 inches; dark gray (2.5Y 4/1) clay loam; few fine faint dark grayish brown (10YR 4/2) mottles; massive; sticky; common medium faint very dark gray (N 3/0) laminations; about 5 percent coarse fragments; few snail shell fragments; slight effervescence; mildly alkaline.

The thickness of the lake sediments, or coprogenous earth, ranges from 30 to more than 80 inches. The coarse fragments are almost all shell fragments. They make up 1 to 25 percent of the lake sediments. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The lake sediments have hue of 10YR, 2.5Y, or 5Y, value of 2 to 4, and chroma of 1 or 2, or they are neutral in hue and have value of 2 or 3 and chroma of 0. The content of organic matter in these sediments ranges from 10 to 50 percent. The 2C horizon, if it occurs, has hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 1 or 2. It is loam, silt loam, clay loam, or silty clay loam.

Vallers Series

The Vallers series consists of poorly drained, moderately slowly permeable soils on ground moraines. These soils formed in calcareous, loamy glacial till. Slopes are 0 to 1 percent.

Typical pedon of Vallers loam, 300 feet east and 150 feet north of the southwest corner of sec. 16, T. 136 N., R. 45 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; about 1 percent coarse fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak—9 to 15 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; few fine white (10YR 8/1) masses of calcium carbonate; about 2 percent coarse fragments; violent effervescence; moderately alkaline; clear smooth boundary.

Bkg—15 to 25 inches; dark gray (5Y 4/1) clay loam; weak fine subangular blocky structure; friable; few medium prominent white (10YR 8/1) concretions of calcium carbonate; about 2 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

Cg—25 to 60 inches; light olive gray (5Y 6/2) clay loam; many medium prominent yellowish brown (10YR 5/6 and 5/8) and few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline.

The content of coarse fragments is 2 to 8 percent in these soils. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The Ap horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It is loam, silt loam, clay loam, or silty clay loam. The lower part of the A horizon is mottled in some pedons. Some pedons do not have an Ak horizon. The Bkg horizon has hue of 2.5Y or 5Y, value of 3 to 6, and chroma of 1 or 2. It is mottled in some pedons. It is clay loam, loam, or silty clay loam. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7, and chroma of 1 to 3. It is loam or clay loam.

Viking Series

The Viking series consists of poorly drained, very slowly permeable soils on lake plains. These soils formed in water-modified, clayey glacial till. Slopes typically are 0 to 1 percent.

Typical pedon of Viking silty clay, 200 feet south and 1,848 feet east of the northwest corner of sec. 6, T. 136 N., R. 46 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

A—9 to 12 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; sticky; about 2 percent coarse fragments; slight effervescence in part of the horizon; mildly alkaline; clear smooth boundary.

Bg—12 to 18 inches; very dark grayish brown (2.5Y 3/2) clay; moderate fine and medium prismatic structure parting to moderate fine and very fine angular blocky; firm; about 2 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

BCg—18 to 27 inches; dark grayish brown (2.5Y 4/2) clay; few fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; weak very fine subangular blocky structure; friable; about 3 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—27 to 41 inches; olive gray (5Y 4/2) clay; common fine distinct brownish yellow (10YR 6/6) and yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; sticky; few gypsum crystals; about 3 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg2—41 to 60 inches; dark gray (5Y 4/1) clay; many fine and medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; weak very fine subangular blocky structure; sticky; few gypsum crystals; about 3 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 36 inches. The mollic epipedon is 9 to 18 inches thick. Some pedons do not have coarse fragments in the A horizon or in the upper part of the B horizon.

The A and Ap horizons have hue of 10YR, value of 2 or 3, and chroma of 1, or they are neutral in hue and have value of 2 and chroma of 0. They are sandy clay loam, clay loam, silty clay loam, silty clay, or clay. The Bg horizon has hue of 2.5Y or 5Y, value of 3 or 4, and chroma of 1 or 2. It has distinct or prominent mottles. It is typically clay, but in some pedons the upper part is silty clay, silty clay loam, or clay loam. The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2.

Wahpeton Series

The Wahpeton series consists of moderately well drained, moderately permeable or moderately slowly permeable soils on stream terraces. These soils formed in fine textured alluvial material. Slopes range from 0 to 15 percent.

Typical pedon of Wahpeton clay, 0 to 2 percent slopes, 100 feet north and 500 feet west of the southeast corner of sec. 2, T. 134 N., R. 48 W.

A—0 to 12 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate very fine angular blocky; firm; neutral; clear smooth boundary.

C—12 to 20 inches; very dark grayish brown (10YR 3/2) clay, gray (10YR 5/1) dry; thin streaks of very dark brown (10YR 2/2) material; moderate and strong fine and very fine subangular blocky structure; very firm; neutral; clear smooth boundary.

Ab—20 to 27 inches; very dark brown (10YR 2/2) clay, gray (2.5Y 5/1) dry; few fine faint very dark grayish brown (2.5Y 3/2) mottles; moderate and strong very fine prismatic structure parting to moderate and strong very fine angular blocky; very firm; slight effervescence; mildly alkaline; clear smooth boundary.

C'1—27 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct very dark gray (2.5Y 3/1) mottles; moderate medium angular blocky structure parting to weak very fine subangular blocky; firm; slight effervescence; mildly alkaline; clear smooth boundary.

C'2—36 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay; few medium distinct olive yellow (2.5Y 6/6) mottles; moderate medium angular blocky structure parting to weak very fine subangular blocky; firm; pockets of black (10YR 2/1) material; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 16 to 40 inches in thickness. One or more Ab horizons are separated by C horizons.

The A and C horizons are clay or silty clay. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 or 2.

Wheatville Series

The Wheatville series consists of somewhat poorly drained soils in lake basins. These soils formed in calareous glaciolacustrine sediments over clayey sediments. They are moderately rapidly permeable in the upper part and slowly permeable in the underlying material. Slopes range from 0 to 6 percent.

Typical pedon of Wheatville silt loam, 0 to 2 percent slopes, 416 feet east and 832 feet south of the northwest corner of sec. 15, T. 131 N., R. 46 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; many fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk—10 to 17 inches; dark gray (10YR 4/1) very fine sandy loam; weak very fine subangular blocky structure; friable; many fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

C—17 to 37 inches; light yellowish brown (2.5Y 6/4) loamy very fine sand; few fine distinct brownish yellow (10YR 6/8) mottles; weak very fine subangular blocky structure; very friable; common fine roots; strong effervescence; moderately alkaline; abrupt wavy boundary.

2C—37 to 60 inches; olive (5Y 4/3) silty clay; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; sticky; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 14 inches thick. The depth to the 2C horizon ranges from 20 to 40 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has value of 2 or 3. It is loam, silt loam, sandy clay loam, or very fine sandy loam. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is very fine sandy loam, loam, silt loam, sandy clay loam, or loamy very fine sand. The C horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 3 or 4. It has faint to prominent mottles. It is loamy very fine sand, very fine sandy loam, silt loam, or loam. The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 3. It has faint to prominent mottles. It is silty clay, clay, or silty clay loam.

Winger Series

The Winger series consists of poorly drained soils on ground moraines. These soils formed in silty glaciolacustrine sediments over loamy glacial till. Permeability is moderate in the upper part of the profile and moderate or moderately slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Winger silt loam, 100 feet east and 2,630 feet south of the northwest corner of sec. 32, T. 136 N., R. 45 W.

A—0 to 10 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bkg1—10 to 19 inches; dark gray (5Y 4/1) silt loam; weak fine subangular blocky structure; very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

Bkg2—19 to 32 inches; dark gray (5Y 4/1) silt loam; weak fine subangular blocky structure; very friable; strong effervescence; moderately alkaline; clear wavy boundary.

2Cg—32 to 60 inches; light olive gray (5Y 6/2) clay loam; common fine prominent yellowish brown (10YR 5/6 and 5/8) mottles; massive; friable; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The thickness of the silty mantle ranges from 24 to 40 inches. The soils are mildly alkaline or moderately alkaline and have free carbonates throughout. The solum is silt loam or silty clay loam. The glaciolacustrine sediments generally are stone free, but in some pedons they have a few pebbles. The content of coarse fragments in the glacial till is 0 to 10 percent. In some pedons a stone line as much as 4 inches thick is between the silty material and the underlying glacial till.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3 and chroma of 0. Some pedons have an Ak horizon. The Bkg horizon has hue of 5Y or 2.5Y, value of

4 to 6, and chroma of 1 or 2. In some pedons it has mottles, which increase in abundance, size, and contrast with increasing depth. The 2C horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It generally has common or many, distinct or prominent mottles. It is loam or clay loam.

Wyndmere Series

The Wyndmere series consists of somewhat poorly drained, moderately rapidly permeable soils on deltas and lake plains. These soils formed in calcareous, loamy sediments. Slopes range from 0 to 2 percent.

Typical pedon of Wyndmere fine sandy loam, 420 feet west and 50 feet north of the southeast corner of sec. 36, T. 136 N., R. 47 W.

A—0 to 11 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak medium granular structure; very friable; strong effervescence; moderately alkaline; clear smooth boundary.

Bk1—11 to 17 inches; dark gray (10YR 4/1) fine sandy loam; weak medium subangular blocky structure parting to weak fine granular; very friable; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—17 to 27 inches; grayish brown (10YR 5/2) fine sandy loam; weak fine subangular blocky structure; very friable; violent effervescence; moderately alkaline; clear smooth boundary.

C1—27 to 37 inches; light yellowish brown (2.5Y 6/4) fine sandy loam; few fine faint yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C2—37 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; many medium distinct yellowish brown (10YR 5/6) and few fine prominent brownish yellow (10YR 6/6 and 6/8) mottles; weak fine subangular blocky structure; very friable; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is fine sandy loam, sandy loam, very fine sandy loam, loam, or loamy very fine sand. The Bk horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. In some pedons it has few fine faint mottles. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7, and chroma of 2 to 4. It has few to many, faint to prominent mottles.

Zell Series

The Zell series consists of well drained, moderately permeable soils on uplands. These soils formed in silty deposits. Slopes range from 1 to 18 percent.

Typical pedon of Zell silt loam, in an area of Zell-Rothsay silt loams, 1 to 4 percent slopes; 950 feet west and 250 feet north of the southeast corner of sec. 10, T. 136 N., R. 45 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; about 1 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

AB—7 to 12 inches; dark grayish brown (2.5Y 4/2) silt loam; weak medium subangular blocky structure; very friable; strong effervescence; moderately alkaline; clear smooth boundary.

Bk—12 to 19 inches; light olive brown (2.5Y 5/4) silt loam; weak very fine subangular structure; violent effervescence; moderately alkaline; clear wavy boundary.

C1—19 to 36 inches; light yellowish brown (2.5Y 6/4) silt loam; weak very fine subangular blocky structure; very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C2—36 to 60 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; many medium distinct brownish yellow (10YR 6/6) relict mottles; weak very fine subangular blocky structure; very friable; slight effervescence; moderately alkaline.

The mollic epipedon generally is 7 to 10 inches thick, but in some pedons it is as much as 16 inches thick. In areas where the mollic epipedon is thicker, it includes part or all of the AB horizon. Some pedons do not have free carbonates in the upper few inches.

The A horizon has value of 2 or 3. It is silt loam, very fine sandy loam, or loam. It is neutral to moderately alkaline. The Bk and C horizons are mildly alkaline or moderately alkaline. The Bk horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 2 to 4. It is silt loam or very fine sandy loam. The C horizon has value of 4 to 6 and chroma of 2 to 4. Its mottles are inherited from the parent material. They vary in amount and contrast. This horizon is dominantly silt loam, loam, or very fine sandy loam. In some pedons, however, it has lenses of finer or coarser textured material in the lower part. In some pedons it has pockets of gypsum crystals.

The eroded Zell soils in Wilkin County are taxadjuncts because they do not have a mollic epipedon. This difference, however, does not significantly affect the use and management of the soils.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material. The factors of soil formation are interdependent. Few generalizations can be made regarding any one factor unless the effects of the others are known.

Parent Material

The soils in the basin of glacial Lake Agassiz formed in calcareous lacustrine deposits or lake-washed glacial till, and those in the uplands formed in calcareous glacial till and outwash. The lacustrine deposits are mainly in the northwestern part of Wilkin County. They extend south along the Red River of the North to Breckenridge. The soils in the northwestern part of the county generally are fine textured, having a clay content of more than 60 percent. Deposits of sand and gravel are on the shorelines of glacial Lake Agassiz.

The remaining areas of the nearly level lake basin cover most of Wilkin County. The soils in these areas typically formed in clay loam and silty clay loam lake-washed till. Some stones and cobbles generally are on and below the surface. Some of the soils are strongly calcareous and have an accumulation of carbonates, whereas others are neutral or slightly acid and have a strongly expressed argillic horizon. Small areas of sandier deposits and parts of old shorelines are included in the lake basin. Some areas of very poorly drained, organic and mineral soils also are included.

The uplands in the northeastern part of the county are about 3 miles wide from east to west and are about 16 miles long. They occur as a complex landscape characterized by short slopes that range from nearly level to hilly. The soils formed dominantly in calcareous, loamy glacial till or in yellowish very fine sandy loam. Coarse fragments are common in most of the soils. In some of these upland areas, the soils formed in outwash, alluvium, or colluvium and range from clay loam to gravelly coarse sand. Very poorly drained, mineral and organic soils also are in these uplands.

Climate

Climate affects the physical, chemical, and biological characteristics of the soil. Rainfall, humidity, and frost influence the availability of moisture and the percolation rate. Percolating water dissolves minerals and transports them downward through the soil profile. Temperature influences the growth of organisms and the speed of chemical reaction in the soil.

Wilkin County has a subhumid, midcontinental climate characterized by wide variations in temperature from summer to winter. The winters are long, and the soil is frozen to a depth of 3 to 5 feet for approximately 6 months of the year. During these cold periods, the soil-forming processes are largely dormant. The growing season averages 131 days. During this season, the soil receives approximately 75 percent of the annual precipitation and the soil-forming processes influenced by climate are most active. The climate is essentially uniform throughout the county. In some small areas, however, differences in vegetation and relief result in variations in the microclimate.

Plants and Animals

Plant and animal life, both in and on the soil, influences the chemical and biological processes of soil formation. Bacteria, earthworms, and other forms of animal life aid in the weathering of soil material and in the decomposition of organic matter. Vegetation, including fungi, adds plant residue to the soil. It affects soil reaction and the transfer of elements in the soil mass. In conjunction with climate and relief, it also affects leaching.

The native vegetation in the basin of glacial Lake Agassiz was principally tall prairie grasses mixed with wetland reeds and sedges. Fire somewhat restricted tree growth in this area. The grasses and sedges that grew throughout most of the glacial lake basin added large amounts of organic matter to the soils. The upland till area in the northeastern part of the county, where the soils formed under mid and tall prairie grasses, was invaded by trees, principally bur oak, red oak, and elm, especially on the well drained soils. This invasion seems to have had little influence on soil formation. Bottom-land hardwoods, such as ash, basswood, elm, and poplar, line the banks and narrow terraces of the major streams in the county. These trees help to stabilize the landscape, but their other effects on soil formation have been minimal.

The effects of animals on soil formation in the county are of minor importance compared to the effects of plants. Earthworms and rodents help to translocate organic material. The shells of snails and other forms of marine life increased the content of carbonates in the soils.

Human activities also have affected soil formation. They have accelerated erosion through the removal of natural vegetation and tillage. They have changed the drainage condition or relief in some areas. Applications of fertilizer and cropping systems that deplete plant nutrients also alter the soil-forming processes and thus soil characteristics.

Relief

Relief influences soil formation through its effect on drainage, aeration, erosion, and vegetation. The relief in Wilkin County results from the deposition of glacial debris and the differential sedimentation and lake washing in the basin of glacial Lake Agassiz and on the beach ridges built up along its old shorelines. The cutting action of streams draining the lake basin, glacial meltwater from the till plain, and the formation of ground moraines by glacial ice also influenced relief.

The glacial lake basin is level and nearly level and has many slightly concave areas. This relief commonly results in poorly drained and somewhat poorly drained soils that have a high content of organic matter and either are gleyed or have an accumulation of carbonates and mottles of varying intensity. Some of the sandy and gravelly soils are steeper and better drained.

The influence of relief is most evident on the glacial till uplands in the northeastern part of the county. On many of the hilltops, knolls, and ridges in this gently sloping to hilly area, the soils have a very thin, dark surface layer and the parent material is exposed. Accelerated erosion commonly has resulted from rapid runoff, drought, and the lack of a protective plant cover. The soils downslope from knolls and ridges commonly have thicker A and B horizons and therefore are deeper to free carbonates than the soils on the knolls and ridges. The more poorly drained soils in pockets and draws are very similar to the poorly drained soils in the lake basin.

Time

Long periods are required for soil formation. The length of time needed for a soil to reach a particular level of development varies. Much less time is required for a soil to form in humid regions that have dense vegetation than for one to form in very cold regions that have little vegetation. Drainage and the nature of the parent material also influence the rate of soil formation. Well drained soils generally form more rapidly than other soils. A soil forms in glacial till or lacustrine sediment much more rapidly than in hard bedrock residuum.

Geologically, the soils in Wilkin county are young. Most of the parent materials were deposited between 9,000 and 12,000 years ago *(4)*. These materials originated as reworked glacial drift and were weathered considerably before they were deposited in their present location.

Many of the soils that formed in glacial till on uplands have distinct A, B, and C horizons. Although they formed over nearly the same length of time as the soils on uplands, many of the soils on glacial lake plains have horizons that are less distinct. They have a dark, highly organic surface layer and commonly have an accumulation of carbonates or a gleyed horizon directly below the surface layer. Some of the soils have an argillic horizon. In a few areas of recent alluvial and colluvial deposits adjacent to the major drainageways or at the base of slopes, the soils show little or no evidence of profile development.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05

millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Campbell, Minnesota)

	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
Month	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	^oF	^oF	^oF	^oF	^oF	Units	In	In	In		In
January-----	15.4	-5.6	4.9	41	-32	0	0.68	0.19	1.06	3	9.9
February----	22.2	.8	11.5	46	-29	0	.63	.19	.97	2	6.0
March-------	34.3	14.2	24.3	65	-19	42	1.01	.40	1.52	3	7.2
April-------	53.2	31.3	42.3	87	10	163	2.35	.96	3.52	5	1.6
May---------	68.4	42.7	55.6	91	25	491	2.50	1.13	3.67	6	.1
June--------	77.2	52.9	65.1	95	36	753	4.00	2.10	5.66	7	.0
July--------	83.2	57.0	70.1	99	42	933	3.07	1.47	4.44	6	.0
August------	81.9	55.0	68.5	99	38	884	2.72	1.04	4.11	5	.0
September---	70.9	44.3	57.6	95	26	528	1.94	.66	2.99	4	.0
October-----	59.4	33.6	46.5	87	15	242	1.44	.50	2.20	3	.4
November----	38.7	19.2	29.0	69	-11	25	.87	.27	1.37	2	3.7
December----	23.2	4.1	13.7	49	-30	10	.65	.18	1.03	2	5.1
Yearly:											
Average---	52.3	29.6	40.8	---	---	---	---	---	---	---	---
Extreme---	---	---	---	101	-35	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,071	21.86	16.00	27.57	48	34.0

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-80 at Campbell, Minnesota)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 17	May 29	May 29
2 years in 10 later than--	May 7	May 17	May 24
5 years in 10 later than--	Apr. 17	Apr. 26	May 14
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 30	Sept. 19	Sept. 6
2 years in 10 earlier than--	Oct. 5	Sept. 24	Sept. 12
5 years in 10 earlier than--	Oct. 15	Oct. 4	Sept. 22

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-80 at Campbell, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	146	123	111
8 years in 10	157	136	118
5 years in 10	180	160	131
2 years in 10	202	184	144
1 year in 10	214	197	151

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
26	Aazdahl clay loam	15,560	3.2
33B	Barnes loam, 1 to 6 percent slopes	2,400	0.5
33B2	Barnes loam, 2 to 6 percent slopes, eroded	2,100	0.4
34	Parnell silt loam	810	0.2
46	Borup loam	1,775	0.4
47	Colvin silty clay loam	5,125	1.1
50	Cashel silty clay	985	0.2
52	Augsburg very fine sandy loam	2,350	0.5
56	Fargo silty clay loam	1,925	0.4
57A	Fargo silty clay, 0 to 2 percent slopes	10,850	2.3
57B	Fargo silty clay, 2 to 6 percent slopes	410	0.1
58	Kittson loam	3,035	0.6
59	Grimstad sandy loam	13,200	2.7
60	Glyndon very fine sandy loam	3,450	0.7
61	Arveson loam	5,325	1.1
63	Rockwell loam	2,375	0.5
64	Ulen fine sandy loam	8,025	1.7
65	Foxhome sandy loam	435	0.1
66	Flaming loamy fine sand	6,100	1.3
67A	Bearden silt loam, 0 to 2 percent slopes	4,850	1.0
67B2	Bearden silt loam, 2 to 6 percent slopes, eroded	1,315	0.3
68	Arveson loam, depressional	395	0.1
71	Fossum loamy fine sand	625	0.1
93	Bearden silty clay loam	875	0.2
107	Winger silt loam	1,675	0.3
108	McIntosh silt loam	1,420	0.3
157A	Wahpeton clay, 0 to 2 percent slopes	1,360	0.3
157B	Wahpeton clay, 2 to 6 percent slopes	210	*
184A	Hamerly clay loam, 0 to 2 percent slopes	74,400	15.5
184B	Hamerly loam, 1 to 4 percent slopes	13,300	2.8
187	Haug muck	4,900	1.0
236	Vallers loam	7,375	1.5
245B	Lohnes loamy sand, 1 to 6 percent slopes	5,300	1.1
290B	Rothsay silt loam, 2 to 4 percent slopes	985	0.2
290B2	Rothsay silt loam, 2 to 6 percent slopes, eroded	360	0.1
293B	Swenoda fine sandy loam, 1 to 4 percent slopes	1,145	0.2
335	Urness mucky silt loam	4,925	1.0
343A	Wheatville silt loam, 0 to 2 percent slopes	10,150	2.1
343B2	Wheatville very fine sandy loam, 2 to 6 percent slopes, eroded	450	0.1
344	Quam silt loam	315	0.1
359	Lamoure silty clay loam, frequently flooded	3,500	0.7
402B	Sioux sandy loam, 1 to 6 percent slopes	1,125	0.2
403	Viking silty clay	1,520	0.3
413	Osakis sandy loam	710	0.1
418	Lamoure silty clay loam, occasionally flooded	3,250	0.7
423	Donaldson very fine sandy loam	13,225	2.7
426	Foldahl loamy fine sand	1,870	0.4
429	Northcote clay	2,100	0.4
435	Syrene sandy loam	635	0.1
494	Darnen silt loam	1,945	0.4
497	Hantho silt loam	1,080	0.2
508	Wyndmere fine sandy loam	11,150	2.3
510	Elmville very fine sandy loam	28,825	6.0
540	Seelyeville muck	835	0.2
547	Deerwood muck	1,545	0.3
582	Roliss clay loam	850	0.2
640	Galchutt silt loam	2,550	0.5
642	Clearwater sandy clay loam	6,375	1.3
645	Espelie fine sandy loam	920	0.2
647	Hilaire loamy fine sand	2,100	0.4
698	Doran clay loam	68,460	14.2
814	Hamerly-Lindaas silty clay loams	41,400	8.6

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
821	Doran-Lindaas complex	9,870	2.1
903B2	Barnes-Langhei loams, 2 to 6 percent slopes, eroded	3,200	0.7
908	Bearden-Fargo complex	500	0.1
942C2	Langhei-Barnes loams, 6 to 12 percent slopes, eroded	2,255	0.5
942D2	Langhei-Barnes loams, 12 to 18 percent slopes, eroded	310	0.1
957B2	Rothsay-Zell silt loams, 2 to 6 percent slopes, eroded	2,400	0.5
969B	Zell-Rothsay silt loams, 1 to 4 percent slopes	1,480	0.3
969C2	Zell-Rothsay silt loams, 6 to 12 percent slopes, eroded	1,240	0.3
969D2	Zell-Rothsay silt loams, 12 to 18 percent slopes, eroded	270	0.1
987	Rockwell fine sandy loam, depressional	230	*
1029	Pits, gravel	950	0.2
1055	Haplaquolls and Histosols, ponded	1,615	0.3
1819	Glyndon silty clay loam	2,520	0.5
1871	Fargo silty clay, swales	1,510	0.3
1872	Fargo silty clay, silty substratum	1,910	0.4
1874	Lohnes sandy loam	4,325	0.9
1913C	Wahpeton-Cashel silty clays, 0 to 15 percent slopes	880	0.2
1916	Lindaas silt loam	15,432	3.2
1921	Foldahl very fine sandy loam	4,850	1.0
1944	Perella silty clay	1,725	0.4
1948	Fargo-Enloe complex	2,650	0.6
1971	Divide loam	2,230	0.5
	Water	200	0.1
	Total	481,087	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
26	Aazdahl clay loam
33B	Barnes loam, 1 to 6 percent slopes
33B2	Barnes loam, 2 to 6 percent slopes, eroded
46	Borup loam (where drained)
47	Colvin silty clay loam (where drained)
50	Cashel silty clay (where drained and either protected from flooding or not frequently flooded during the growing season)
52	Augsburg very fine sandy loam (where drained)
56	Fargo silty clay loam (where drained)
57A	Fargo silty clay, 0 to 2 percent slopes (where drained)
57B	Fargo silty clay, 2 to 6 percent slopes (where drained)
58	Kittson loam
59	Grimstad sandy loam
60	Glyndon very fine sandy loam
61	Arveson loam (where drained)
63	Rockwell loam (where drained)
65	Foxhome sandy loam
67A	Bearden silt loam, 0 to 2 percent slopes
67B2	Bearden silt loam, 2 to 6 percent slopes, eroded
93	Bearden silty clay loam
107	Winger silt loam (where drained)
108	McIntosh silt loam
157A	Wahpeton clay, 0 to 2 percent slopes
157B	Wahpeton clay, 2 to 6 percent slopes
184A	Hamerly clay loam, 0 to 2 percent slopes
184B	Hamerly loam, 1 to 4 percent slopes
236	Vallers loam (where drained)
290B	Rothsay silt loam, 2 to 4 percent slopes
290B2	Rothsay silt loam, 2 to 6 percent slopes, eroded
293B	Swenoda fine sandy loam, 1 to 4 percent slopes
343A	Wheatville silt loam, 0 to 2 percent slopes
343B2	Wheatville very fine sandy loam, 2 to 6 percent slopes, eroded
403	Viking silty clay (where drained)
418	Lamoure silty clay loam, occasionally flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
425	Donaldson very fine sandy loam
429	Northcote clay (where drained)
494	Darnen silt loam
497	Hantho silt loam
508	Wyndmere fine sandy loam
510	Elmville very fine sandy loam
582	Roliss clay loam (where drained)
640	Galchutt silt loam
642	Clearwater sandy clay loam (where drained)
645	Espelie fine sandy loam (where drained)
698	Doran clay loam
814	Hamerly-Lindaas silty clay loams (where drained)
821	Doran-Lindaas complex (where drained)
903B2	Barnes-Langhei loams, 2 to 6 percent slopes, eroded
908	Bearden-Fargo complex (where drained)
957B2	Rothsay-Zell silt loams, 2 to 6 percent slopes, eroded
969B	Zell-Rothsay silt loams, 1 to 4 percent slopes
1819	Glyndon silty clay loam
1871	Fargo silty clay, swales (where drained)
1872	Fargo silty clay, silty substratum (where drained)
1916	Lindaas silt loam (where drained)
1921	Foldahl very fine sandy loam
1944	Perella silty clay (where drained)
1948	Fargo-Enloe complex (where drained)
1971	Divide loam

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Soybeans	Corn	Sugar beets	Grass-legume hay
		Bu	Bu	Bu	Bu	Bu	Tons	Tons
26--------------- Aazdahl	I	50	92	72	38	90	20.5	3.7
33B-------------- Barnes	IIe	48	92	71	36	90	---	3.6
33B2------------- Barnes	IIe	45	89	68	33	85	---	3.4
34--------------- Parnell	IIIw	27	68	50	20	58	---	3.5
46--------------- Borup	IIw	42	83	66	29	84	17.0	3.6
47--------------- Colvin	IIw	43	84	67	30	85	17.6	3.6
50--------------- Cashel	IIw	36	74	58	25	72	15.0	3.6
52--------------- Augsburg	IIw	42	83	66	29	84	17.7	3.7
56--------------- Fargo	IIw	45	86	67	33	85	18.5	3.6
57A, 57B--------- Fargo	IIw	43	83	64	31	81	18.0	3.4
58--------------- Kittson	I	48	91	70	36	90	19.5	3.6
59--------------- Grimstad	IIs	38	84	60	28	85	15.5	3.2
60--------------- Glyndon	IIs	46	88	70	32	91	19.0	3.5
61--------------- Arveson	IIIw	33	67	53	23	68	---	3.3
63--------------- Rockwell	IIw	38	75	58	25	74	---	3.4
64--------------- Ulen	IIIs	37	80	59	26	83	---	3.0
65--------------- Foxhome	IIIs	37	80	57	26	79	---	3.0
66--------------- Flaming	IVs	27	61	45	21	72	---	2.5
67A-------------- Bearden	IIs	48	90	71	34	90	20.0	3.8
67B2------------- Bearden	IIe	45	86	66	30	85	17.5	3.5

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Soybeans	Corn	Sugar beets	Grass-legume hay
		Bu	Bu	Bu	Bu	Bu	Tons	Tons
68-------------- Arveson	IVw	18	48	32	10	37	---	2.9
71-------------- Fossum	IVw	26	58	45	19	64	---	2.8
93-------------- Bearden	IIs	48	89	70	33	89	19.8	3.9
107------------- Winger	IIw	38	70	58	22	70	16.5	3.6
108------------- McIntosh	IIs	45	85	66	29	85	18.3	3.8
157A------------ Wahpeton	IIw	49	91	71	37	91	19.5	3.8
157B------------ Wahpeton	IIe	44	88	66	33	87	18.0	3.7
184A------------ Hamerly	IIs	47	88	69	32	89	19.3	3.8
184B------------ Hamerly	IIe	45	87	67	31	86	18.5	3.7
187------------- Haug	IIIw	18	45	30	---	35	---	3.0
236------------- Vallers	IIw	39	79	60	30	75	16.8	4.0
245B------------ Lohnes	IVs	18	42	28	13	40	---	1.4
290B------------ Rothsay	IIe	48	91	71	36	90	---	3.5
290B2----------- Rothsay	IIe	45	86	68	34	87	---	3.3
293B------------ Swenoda	IIe	39	85	64	29	85	16.5	3.1
335------------- Urness	IIIw	19	54	36	---	38	---	3.2
343A------------ Wheatville	IIs	47	88	70	32	90	19.0	3.7
343B2----------- Wheatville	IIe	43	84	65	28	84	17.0	3.4
344------------- Quam	IIIw	29	70	53	22	58	---	3.7
359------------- Lamoure	VIw	---	---	---	---	---	---	---
402B------------ Sioux	VIs	---	---	---	---	---	---	---

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Soybeans	Corn	Sugar beets	Grass-legume hay
		Bu	Bu	Bu	Bu	Bu	Tons	Tons
403------------- Viking	IIw	43	85	65	31	82	18.2	3.6
413------------- Osakis	IIIs	33	78	53	23	78	---	2.8
418------------- Lamoure	IIw	35	71	57	24	70	14.5	3.5
425------------- Donaldson	I	46	90	69	35	91	18.0	3.6
426------------- Foldahl	IIIs	33	79	53	23	75	---	2.7
429------------- Northcote	IIw	42	84	64	31	---	18.0	3.6
435------------- Syrene	IVw	31	65	50	21	68	---	3.3
494------------- Darnen	I	48	91	70	37	91	---	4.0
497------------- Hantho	I	49	91	71	39	92	---	3.8
508------------- Wyndmere	IIs	43	87	68	31	89	16.8	3.3
510------------- Elmville	IIs	44	88	69	32	89	17.8	3.5
540------------- Seelyeville	VIw	---	---	---	---	---	---	---
547------------- Deerwood	VIw	---	---	---	---	---	---	---
582------------- Roliss	IIw	41	80	63	28	82	---	3.5
640------------- Galchutt	IIw	47	91	69	37	90	18.7	3.6
642------------- Clearwater	IIw	44	89	67	31	85	18.0	3.7
645------------- Espelie	IIw	37	82	58	26	78	---	3.2
647------------- Hilaire	IIIs	33	80	52	24	76	---	2.8
698------------- Doran	IIw	47	90	69	36	89	19.0	3.6
814------------- Hamerly-Lindaas	IIw	42	85	64	30	85	17.0	3.5
821------------- Doran-Lindaas	IIw	43	86	65	32	86	17.0	3.6

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Soybeans	Corn	Sugar beets	Grass-legume hay
		Bu	Bu	Bu	Bu	Bu	Tons	Tons
903B2-----------		44	87	66	32	88	---	3.2
Barnes---------	IIe							
Langhei--------	IIIe							
908------------ Bearden-Fargo	IIw	43	85	66	31	86	18.0	3.7
942C2-----------		36	78	58	24	75	---	2.5
Langhei--------	IVe							
Barnes---------	IIIe							
942D2-----------		29	64	50	18	65	---	1.7
Langhei--------	VIe							
Barnes---------	IVe							
957B2-----------		45	88	67	32	89	---	3.2
Rothsay--------	IIe							
Zell-----------	IIIe							
969B------------		46	88	68	33	90	---	3.3
Zell-----------	IIIe							
Rothsay--------	IIe							
969C2-----------		36	78	60	24	76	---	2.5
Zell-----------	IVe							
Rothsay--------	IIIe							
969D2-----------		30	65	50	18	66	---	1.8
Zell-----------	VIe							
Rothsay--------	IVe							
987------------- Rockwell	IIIw	20	55	36	13	40	---	3.0
1029*. Pits								
1055------------ Haplaquolls and Histosols	VIIIw	---	---	---	---	---	---	---
1819------------ Glyndon	IIs	47	87	70	31	90	19.3	3.7
1871------------ Fargo	IIIw	40	80	62	26	78	16.0	3.4
1872------------ Fargo	IIw	46	88	69	35	87	19.2	4.0
1874------------ Lohnes	IVs	24	57	41	20	68	---	2.0
1913C-----------		---	---	---	---	---	---	---
Wahpeton-------	IIIe							
Cashel---------	VIw							
1916------------ Lindaas	IIw	36	78	58	24	73	15.5	3.4

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Soybeans	Corn	Sugar beets	Grass-legume hay
		Bu	Bu	Bu	Bu	Bu	Tons	Tons
1921----------- Foldahl	IIs	37	85	64	29	84	14.0	2.9
1944----------- Perella	IIw	48	89	71	37	90	---	3.8
1948----------- Fargo-Enloe	IIw	42	83	64	32	85	17.8	3.7
1971----------- Divide	IIIs	36	78	58	26	78	---	3.2

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
26 Aazdahl	---	Blue spruce, eastern redcedar, American plum, Siberian peashrub, Peking cotoneaster, redosier dogwood.	Siberian crabapple, white spruce, Black Hills spruce, Russian-olive, common chokecherry.	Golden willow, green ash.	Eastern cottonwood, robusta cottonwood.
33B, 33B2 Barnes	Peking cotoneaster	Eastern redcedar, Siberian peashrub, American plum, late lilac, common chokecherry, silver buffaloberry.	Blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Green ash, honeylocust, hackberry, Siberian elm.	Silver maple, eastern cottonwood.
34 Parnell	Redosier dogwood	Siberian peashrub	Black Hills spruce, white spruce, green ash.	Golden willow, Siberian elm, white willow.	Eastern cottonwood.
46 Borup	Redosier dogwood	Siberian peashrub	Russian-olive, blue spruce, white spruce, green ash.	Golden willow, Siberian elm, white willow.	Eastern cottonwood.
47 Colvin	Peking cotoneaster	Redosier dogwood, American plum, Siberian peashrub, common chokecherry, late lilac.	Siberian crabapple, white spruce, blue spruce, hackberry, Black Hills spruce.	Golden willow, green ash.	Eastern cottonwood, Carolina poplar.
50 Cashel	---	Redosier dogwood, Peking cotoneaster, eastern redcedar, Siberian peashrub, American plum, late lilac, silver buffaloberry.	Black Hills spruce, Russian-olive, white spruce, Siberian crabapple.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple, white willow, Carolina poplar.
52 Augsburg	Redosier dogwood	Late lilac, Siberian peashrub, eastern redcedar, American plum.	Russian-olive, bur oak, white spruce, blue spruce, Black Hills spruce, Siberian crabapple, hackberry, green ash.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
56, 57A, 57B Fargo	Peking cotoneaster	Redosier dogwood, American plum, Siberian peashrub, common chokecherry, eastern redcedar, late lilac, silver buffaloberry.	Siberian crabapple, Black Hills spruce, white spruce, ponderosa pine, Russian-olive.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple.
58 Kittson	---	Eastern redcedar, Peking cotoneaster, American plum, late lilac, redosier dogwood, Siberian peashrub, blue spruce.	White spruce, Black Hills spruce, ponderosa pine, Russian-olive, common chokecherry.	Golden willow, green ash.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
59 Grimstad	---	Eastern redcedar, common chokecherry, late lilac, Siberian peashrub, silver buffaloberry.	Russian-olive, white spruce, bur oak, hackberry, ponderosa pine, Black Hills spruce, Siberian crabapple.	Golden willow, green ash, white willow.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
60 Glyndon	---	Eastern redcedar, late lilac, Siberian peashrub, common chokecherry, silver buffaloberry.	White spruce, bur oak, Russian-olive, Black Hills spruce, ponderosa pine.	Golden willow, green ash, white willow.	Eastern cottonwood, Siouxland cottonwood.
61 Arveson	Redosier dogwood	Siberian peashrub, late lilac, eastern redcedar, common chokecherry, American plum.	Blue spruce, Russian-olive, white spruce, bur oak, hackberry, Black Hills spruce, ponderosa pine, green ash.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
63 Rockwell	Redosier dogwood	Siberian peashrub, eastern redcedar, common chokecherry, American plum.	Bur oak, Russian-olive, white spruce, blue spruce, Black Hills spruce, ponderosa pine, hackberry, green ash.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
64 Ulen	---	Eastern redcedar, common chokecherry, Siberian peashrub, silver buffaloberry, late lilac, American plum.	Russian-olive, white spruce, bur oak, Black Hills spruce, ponderosa pine, hackberry, Manchurian crabapple.	Golden willow, white willow, green ash.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
65---------------- Foxhome	Late lilac, Peking cotoneaster.	Eastern redcedar, American plum, Siberian peashrub, silver buffaloberry, bur oak, Manchurian crabapple, Siberian crabapple, common chokecherry.	Black Hills spruce, jack pine, ponderosa pine, red pine, green ash, hackberry, Russian-olive.	Siberian elm------	Robusta cottonwood, Carolina poplar.
66---------------- Flaming	---	Eastern redcedar, blue spruce, American plum, Siberian peashrub, Peking cotoneaster, late lilac, redosier dogwood.	Siberian crabapple, white spruce, Black Hills spruce, ponderosa pine, hackberry, Russian-olive, common chokecherry.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, robusta cottonwood, silver maple, Siouxland cottonwood.
67A, 67B2--------- Bearden	---	Siberian peashrub, American plum, late lilac, silver buffaloberry, eastern redcedar.	Hackberry, common chokecherry, ponderosa pine, Siberian crabapple, Black Hills spruce, Russian-olive.	Golden willow, hackberry, green ash.	Eastern cottonwood, robusta cottonwood.
68---------------- Arveson	Redosier dogwood	Late lilac, eastern redcedar, Siberian peashrub, American plum.	Green ash, hackberry, Black Hills spruce.	Golden willow-----	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
71---------------- Fossum	Redosier dogwood	Siberian peashrub, lilac, eastern redcedar, common chokecherry, American plum.	Russian-olive, bur oak, white spruce, blue spruce, Black Hills spruce, hackberry, Manchurian crabapple, green ash.	Golden willow-----	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
93---------------- Bearden	---	Siberian peashrub, American plum, late lilac, silver buffaloberry.	Ponderosa pine, hackberry, Siberian crabapple, Russian-olive, Black Hills spruce.	Golden willow, green ash.	Eastern cottonwood, robusta cottonwood.
107--------------- Winger	Redosier dogwood	Siberian peashrub, common lilac, common chokecherry, eastern redcedar, American plum.	Blue spruce, white spruce, Russian-olive, bur oak, Black Hills spruce, ponderosa pine, hackberry, Siberian crabapple.	Golden willow-----	Eastern cottonwood, Siberian elm, Siouxland cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
108 McIntosh	Lilac	Siberian peashrub, common chokecherry, late lilac, American plum, eastern redcedar, silver buffaloberry.	Russian-olive, white spruce, bur oak, Black Hills spruce, ponderosa pine, hackberry, Siberian crabapple.	Golden willow, green ash, white willow.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
157A, 157B Wahpeton	---	Manchurian crabapple, Peking cotoneaster, redosier dogwood, eastern redcedar, Siberian peashrub, American plum.	Black Hills spruce, ponderosa pine, Russian-olive, common chokecherry, hackberry.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, Siouxland cottonwood, robusta cottonwood, silver maple.
184A, 184B Hamerly	---	Siberian peashrub, American plum, late lilac, silver buffaloberry, eastern redcedar.	Hackberry, ponderosa pine, Siberian crabapple, Black Hills spruce, Russian-olive.	Golden willow, white willow, green ash.	Eastern cottonwood, robusta cottonwood, Siouxland cottonwood.
187 Haug	Redosier dogwood	Siberian peashrub	Green ash	White willow, golden willow.	Carolina poplar.
236 Vallers	Redosier dogwood	Siberian peashrub, common chokecherry, eastern redcedar, late lilac, American plum.	Green ash, white spruce, bur oak, Russian-olive, blue spruce, Black Hills spruce, ponderosa pine, hackberry, Siberian crabapple.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
245B Lohnes	Peking cotoneaster	Eastern redcedar, Siberian peashrub, common chokecherry.	Ponderosa pine, Russian-olive, red pine.	Siberian elm, green ash.	Eastern cottonwood, silver maple.
290B, 290B2 Rothsay	Peking cotoneaster	Eastern redcedar, Amur maple, redosier dogwood, Siberian peashrub, American plum, late lilac.	Blue spruce, green ash, ponderosa pine, Russian-olive, Siberian crabapple, Black Hills spruce, Scotch pine.	Hackberry, Siberian elm.	Silver maple, Siouxland cottonwood, eastern cottonwood.
293B Swenoda	Peking cotoneaster	Eastern redcedar, Siberian peashrub, lilac, American plum, late lilac.	Hackberry, ponderosa pine, Russian-olive, Black Hills spruce.	Siberian elm, green ash.	Eastern cottonwood, silver maple.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
335 Urness	Redosier dogwood	Siberian peashrub, silver buffaloberry.	Russian-olive, green ash, hackberry.	White willow, golden willow, Siberian elm.	Eastern cottonwood, robusta cottonwood.
343A, 343B2 Wheatville	---	Late lilac, common chokecherry, eastern redcedar, Siberian peashrub, American plum, silver buffaloberry.	White spruce, Russian-olive, bur oak, Black Hills spruce, ponderosa pine, Siberian crabapple, hackberry.	Golden willow, white willow, green ash.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
344 Quam	Redosier dogwood	Siberian peashrub	Russian-olive, green ash.	Golden willow, white willow, Siberian elm.	Eastern cottonwood, robusta cottonwood.
359 Lamoure	Peking cotoneaster	Eastern redcedar, American plum, late lilac, redosier dogwood, Siberian peashrub, silver buffaloberry.	Black Hills spruce, blue spruce, white spruce, bur oak, hackberry.	Green ash, Siberian elm, golden willow.	Eastern cottonwood, white willow, silver maple, Carolina poplar.
402B. Sioux					
403 Viking	Redosier dogwood	Common chokecherry, Siberian peashrub, eastern redcedar, late lilac, American plum.	Blue spruce, Russian-olive, bur oak, white spruce, Black Hills spruce, ponderosa pine.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
413 Osakis	---	Late lilac, redosier dogwood, Siberian peashrub, blue spruce, Amur maple, silver buffaloberry.	White spruce, common chokecherry, Black Hills spruce, Siberian crabapple, Russian-olive.	Siberian elm, green ash, golden willow.	Robusta cottonwood, eastern cottonwood, Siouxland cottonwood, silver maple.
418 Lamoure	Peking cotoneaster	Siberian peashrub, late lilac, silver buffaloberry, American plum, common chokecherry.	Blue spruce, ponderosa pine, Siberian crabapple, bur oak, Black Hills spruce, hackberry.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, white willow, silver maple.
425 Donaldson	---	Siberian peashrub, eastern redcedar, late lilac, silver buffaloberry.	Russian-olive, white spruce, Black Hills spruce, ponderosa pine, hackberry.	Golden willow, green ash.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
426--------------- Foldahl	---	Eastern redcedar, Peking cotoneaster, Siberian peashrub, redosier dogwood, late lilac, Amur maple, blue spruce, silver buffaloberry.	Siberian crabapple, white spruce, Black Hills spruce, common chokecherry, ponderosa pine, Russian-olive, hackberry.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple, robusta cottonwood, Siouxland cottonwood.
429--------------- Northcote	Peking cotoneaster	Eastern redcedar, silver buffaloberry, common chokecherry, redosier dogwood, late lilac, American plum, Siberian peashrub.	Amur maple, ponderosa pine, blue spruce, white spruce, Siberian crabapple, Black Hills spruce.	Golden willow, green ash, Siberian elm.	Northwest poplar, eastern cottonwood, white willow, silver maple.
435--------------- Syrene	Redosier dogwood	Common chokecherry, Siberian peashrub, American plum, eastern redcedar, common lilac.	Blue spruce, white spruce, Russian-olive, bur oak, green ash, Black Hills spruce, ponderosa pine, hackberry, Siberian crabapple.	Golden willow-----	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
494--------------- Darnen	Peking cotoneaster	Eastern redcedar, Siberian peashrub, redosier dogwood, late lilac, Amur maple, silver buffaloberry.	Ponderosa pine, Russian-olive, Siberian crabapple, Black Hills spruce.	Siberian elm, hackberry.	Siouxland cottonwood, eastern cottonwood, silver maple.
497--------------- Hantho	Peking cotoneaster	Eastern redcedar, redosier dogwood, Siberian peashrub, late lilac, silver buffaloberry.	Green ash, ponderosa pine, Russian-olive, bur oak, Siberian crabapple, Black Hills spruce.	Siberian elm, hackberry.	Siouxland cottonwood, eastern cottonwood, silver maple.
508--------------- Wyndmere	---	Siberian peashrub, late lilac, American plum, eastern redcedar, silver buffaloberry.	Russian-olive, white spruce, ponderosa pine, Black Hills spruce, Siberian crabapple, hackberry.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, Siouxland cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
510 Elmville	---	Siberian peashrub, common chokecherry, late lilac, eastern redcedar, silver buffaloberry.	Russian-olive, white spruce, bur oak, ponderosa pine, Black Hills spruce, Siberian crabapple, hackberry.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, Siouxland cottonwood.
540 Seelyeville	Redosier dogwood	Siberian peashrub	Green ash	Golden willow, white willow.	Carolina poplar.
547 Deerwood	Redosier dogwood	Siberian peashrub	Green ash	Golden willow, white willow.	Carolina poplar.
582 Roliss	Redosier dogwood	Siberian peashrub, late lilac, eastern redcedar, common chokecherry, American plum, silver buffaloberry.	White spruce, blue spruce, bur oak, Russian-olive, Black Hills spruce, Siberian crabapple, ponderosa pine.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
640 Galchutt	---	Blue spruce, silver buffaloberry, late lilac, redosier dogwood, eastern redcedar, Peking cotoneaster, Amur maple, Siberian peashrub.	Black Hills spruce, ponderosa pine, hackberry, common chokecherry, Siberian crabapple, Russian-olive, white spruce.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, robusta cottonwood, Siouxland cottonwood, silver maple.
642 Clearwater	Redosier dogwood	Late lilac, eastern redcedar, Siberian peashrub, common chokecherry, American plum.	Ponderosa pine, white spruce, bur oak, blue spruce, Russian-olive, Black Hills spruce, hackberry, Siberian crabapple.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
645 Espelie	Peking cotoneaster	Siberian peashrub, late lilac, American plum, redosier dogwood, common chokecherry, silver buffaloberry.	White spruce, Siberian crabapple, blue spruce, Amur maple, Black Hills spruce, hackberry, Russian-olive.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, white willow, silver maple.
647 Hilaire	---	Redosier dogwood, eastern redcedar, blue spruce, Peking cotoneaster, late lilac, Siberian peashrub, silver buffaloberry.	Siberian crabapple, white spruce, Black Hills spruce, ponderosa pine, Russian-olive, common chokecherry, hackberry.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple, Siouxland cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
698----- Doran	---	Siberian peashrub, late lilac, blue spruce, Peking cotoneaster, eastern redcedar, Amur maple, silver buffaloberry, redosier dogwood.	Ponderosa pine, white spruce, Siberian crabapple, common chokecherry, Black Hills spruce, Russian-olive.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, robusta cottonwood, Siouxland cottonwood, silver maple.
814*: Hamerly-----	---	Siberian peashrub, American plum, late lilac, silver buffaloberry, eastern redcedar.	Ponderosa pine, Siberian crabapple, Russian-olive, Black Hills spruce, hackberry.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, Siouxland cottonwood.
Lindaas-----	Peking cotoneaster	Late lilac, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Siberian crabapple, Black Hills spruce, white spruce, blue spruce, ponderosa pine, Amur maple, bur oak.	Golden willow, green ash, Siberian elm, hackberry.	Eastern cottonwood, white willow, silver maple, Carolina poplar.
821*: Doran-----	---	Siberian peashrub, late lilac, eastern redcedar, Amur maple, Peking cotoneaster, silver buffaloberry, redosier dogwood.	Ponderosa pine, white spruce, Siberian crabapple, hackberry, Black Hills spruce, Russian-olive.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, Siouxland cottonwood, robusta cottonwood, silver maple.
Lindaas-----	Peking cotoneaster	Lilac, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Siberian crabapple, Black Hills spruce, white spruce, blue spruce, ponderosa pine, Amur maple, bur oak, hackberry, red pine, Scotch pine.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, white willow, silver maple, Siouxland cottonwood.
903B2*: Barnes-----	Peking cotoneaster	Eastern redcedar, Siberian peashrub, American plum, late lilac, Amur maple, redosier dogwood, silver buffaloberry.	Blue spruce, ponderosa pine, Russian-olive, Siberian crabapple, Black Hills spruce, green ash.	Siberian elm, hackberry.	Eastern cottonwood, Siouxland cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
903B2*:					
Langhei	Late lilac, Siberian peashrub, common lilac.	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, Russian-olive, silver buffaloberry, blue spruce.	Siberian elm, green ash.	Eastern cottonwood.	---
908*:					
Bearden	---	Siberian peashrub, American plum, late lilac, silver buffaloberry, eastern redcedar.	Common chokecherry, ponderosa pine, Siberian crabapple, hackberry, eastern redcedar, Russian-olive, Black Hills spruce.	Siberian elm, golden willow, green ash.	Eastern cottonwood, robusta cottonwood, Siouxland cottonwood.
Fargo	Peking cotoneaster	Redosier dogwood, American plum, Siberian peashrub, common chokecherry, eastern redcedar, late lilac, silver buffaloberry.	Siberian crabapple, Black Hills spruce, blue spruce, ponderosa pine, Amur maple.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, silver maple.
942C2*, 942D2*:					
Langhei	Late lilac, Siberian peashrub.	American plum, blue spruce, eastern redcedar, Rocky Mountain juniper, ponderosa pine, Russian-olive, silver buffaloberry.	Siberian elm, green ash.	Eastern cottonwood.	---
Barnes	Peking cotoneaster	Eastern redcedar, Siberian peashrub, American plum, late lilac, redosier dogwood, silver buffaloberry.	Blue spruce, ponderosa pine, Russian-olive, Siberian crabapple, bur oak, red pine, Black Hills spruce, Scotch pine.	Siberian elm, hackberry.	Silver maple, Siouxland cottonwood, eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
957B2*:					
Rothsay	Peking cotoneaster	Eastern redcedar, redosier dogwood, Siberian peashrub, American plum, late lilac, silver buffaloberry.	Blue spruce, ponderosa pine, Russian-olive, Siberian crabapple, green ash, Black Hills spruce.	Hackberry, Siberian elm.	Silver maple, Siouxland cottonwood, eastern cottonwood.
Zell	Late lilac, Siberian peashrub.	Russian-olive, eastern redcedar, Rocky Mountain juniper, blue spruce, American plum, silver buffaloberry, ponderosa pine.	Siberian elm, green ash.	Eastern cottonwood.	---
969B*, 969C2*:					
Zell	Late lilac, Siberian peashrub, common lilac.	Russian-olive, blue spruce, eastern redcedar, Rocky Mountain juniper, ponderosa pine, silver buffaloberry.	Green ash	Eastern cottonwood.	---
Rothsay	Peking cotoneaster	Eastern redcedar, redosier dogwood, Siberian peashrub, American plum, late lilac.	Blue spruce, green ash, ponderosa pine, Russian-olive, Siberian crabapple, Black Hills spruce.	Hackberry, Siberian elm.	Silver maple, Siouxland cottonwood, eastern cottonwood.
969D2*:					
Zell	Late lilac, Siberian peashrub, common lilac.	Russian-olive, blue spruce, eastern redcedar, Rocky Mountain juniper, ponderosa pine, silver buffaloberry.	Green ash	Eastern cottonwood.	---
Rothsay	Peking cotoneaster	Eastern redcedar, redosier dogwood, Siberian peashrub, American plum, late lilac.	Blue spruce, green ash, ponderosa pine, Russian-olive, Siberian crabapple, Black Hills spruce.	Hackberry, Siberian elm.	Silver maple, Siouxland cottonwood, eastern cottonwood.
987 Rockwell	Redosier dogwood	Eastern redcedar, common chokecherry, Siberian peashrub, common lilac, American plum.	Bur oak, blue spruce, white spruce, Russian-olive, Black Hills spruce, ponderosa pine, hackberry, green ash, Siberian crabapple.	Golden willow	Eastern cottonwood, Siberian elm, Siouxland cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1029*. Pits					
1055*: Haplaquolls.					
Histosols.					
1819 Glyndon	---	Late lilac, eastern redcedar, silver buffaloberry, Siberian peashrub, common chokecherry, American plum.	Ponderosa pine, white spruce, bur oak, Russian-olive, Black Hills spruce, hackberry.	Golden willow, green ash, white willow.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.
1871 Fargo	Peking cotoneaster	Redosier dogwood, lilac, Siberian peashrub, common chokecherry, American plum, eastern redcedar, silver buffaloberry.	Siberian crabapple, blue spruce, white spruce, Black Hills spruce, Amur maple, ponderosa pine, hackberry.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, Carolina poplar, white willow, silver maple.
1872 Fargo	---	Amur maple, American plum, Siberian peashrub, eastern redcedar, late lilac, redosier dogwood, silver buffaloberry.	Black Hills spruce, Siberian crabapple, common chokecherry, hackberry, Russian-olive, ponderosa pine.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, silver maple, Siouxland cottonwood.
1874 Lohnes	Peking cotoneaster	Eastern redcedar, Siberian peashrub, American plum, silver buffaloberry, Siberian crabapple, common chokecherry.	Ponderosa pine, Russian-olive, hackberry, red pine, Black Hills spruce.	Siberian elm, green ash.	Eastern cottonwood, silver maple.
1913C*:					
Wahpeton	---	Late lilac, Amur maple, silver buffaloberry, Peking cotoneaster, redosier dogwood, eastern redcedar, Siberian peashrub, American plum, blue spruce.	Black Hills spruce, white spruce, common chokecherry, hackberry, Russian-olive, ponderosa pine, Siberian crabapple.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple, Siouxland cottonwood, robusta cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1913C*: Cashel	---	Redosier dogwood, Peking cotoneaster, eastern redcedar, late lilac, Siberian peashrub, Amur maple, American plum, silver buffaloberry, blue spruce.	Black Hills spruce, white spruce, common chokecherry, hackberry, Russian-olive, ponderosa pine, Siberian crabapple.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple, Siouxland cottonwood, robusta cottonwood.
1916 Lindaas	Peking cotoneaster	Late lilac, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub, silver buffaloberry, American plum.	Siberian crabapple, Black Hills spruce, Amur maple, bur oak, ponderosa pine, blue spruce, hackberry.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, white willow, silver maple.
1921 Foldahl	---	Eastern redcedar, American plum, Amur maple, blue spruce, late lilac, Peking cotoneaster, Siberian peashrub, redosier dogwood, silver buffaloberry.	Siberian crabapple, white spruce, hackberry, common chokecherry, Black Hills spruce, ponderosa pine, Russian-olive.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple, Siouxland cottonwood, robusta cottonwood.
1944 Perella	---	Eastern redcedar, American plum, Siberian peashrub, redosier dogwood, Peking cotoneaster, late lilac, blue spruce, silver buffaloberry, Amur maple.	Black Hills spruce, Russian-olive, ponderosa pine, hackberry, common chokecherry, Siberian crabapple.	Golden willow, green ash, Siberian elm.	Eastern cottonwood, silver maple, Siouxland cottonwood, robusta cottonwood.
1948*: Fargo	Peking cotoneaster	Redosier dogwood, American plum, Siberian peashrub, common chokecherry, eastern redcedar, late lilac, silver buffaloberry.	Siberian crabapple, Black Hills spruce, blue spruce, ponderosa pine, Amur maple, white spruce.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1948*: Enloe	Peking cotoneaster	Redosier dogwood, common chokecherry, Siberian peashrub, eastern redcedar, late lilac, American plum, silver buffaloberry.	Siberian crabapple, Black Hills spruce, white spruce, blue spruce, ponderosa pine, hackberry, Amur maple.	Golden willow, Siberian elm, green ash.	Eastern cottonwood, silver maple, white willow.
1971 Divide	---	Eastern redcedar, Siberian peashrub, common lilac, common chokecherry, American plum, silver buffaloberry.	White spruce, bur oak, Russian-olive, Siberian crabapple, Black Hills spruce, ponderosa pine, hackberry.	Golden willow, green ash, white willow.	Eastern cottonwood, Siberian elm, Siouxland cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
26 Aazdahl	Slight	Slight	Slight	Slight	Slight.
33B, 33B2 Barnes	Slight	Slight	Moderate: slope.	Slight	Slight.
34 Parnell	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
46 Borup	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
47 Colvin	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
50 Cashel	Severe: flooding, wetness.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
52 Augsburg	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
56 Fargo	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
57A, 57B Fargo	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
58 Kittson	Slight	Slight	Slight	Slight	Slight.
59 Grimstad	Slight	Slight	Slight	Slight	Slight.
60 Glyndon	Slight	Slight	Slight	Slight	Slight.
61 Arveson	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
63 Rockwell	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
64 Ulen	Slight	Slight	Slight	Slight	Moderate: droughty.
65 Foxhome	Slight	Slight	Slight	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
66 Flaming	Slight	Slight	Slight	Slight	Moderate: droughty.
67A Bearden	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Slight	Slight.
67B2 Bearden	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness.	Slight	Slight.
68 Arveson	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
71 Fossum	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
93 Bearden	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Slight	Slight.
107 Winger	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
108 McIntosh	Slight	Slight	Slight	Slight	Slight.
157A Wahpeton	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
157B Wahpeton	Severe: flooding.	Moderate: too clayey.	Moderate: slope, too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
184A Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight	Slight.
184B Hamerly	Slight	Slight	Moderate: slope.	Slight	Slight.
187 Haug	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
236 Vallers	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
245B Lohnes	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
290B, 290B2 Rothsay	Slight	Slight	Moderate: slope.	Slight	Slight.
293B Swenoda	Slight	Slight	Moderate: slope.	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
335 Urness	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.
343A Wheatville	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight.
343B2 Wheatville	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
344 Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
359 Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
402B Sioux	Slight	Slight	Moderate: slope, small stones.	Slight	Severe: droughty.
403 Viking	Severe: flooding, wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.
413 Osakis	Slight	Slight	Slight	Slight	Moderate: droughty.
418 Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
425 Donaldson	Slight	Slight	Slight	Slight	Slight.
426 Foldahl	Slight	Slight	Slight	Slight	Moderate: droughty.
429 Northcote	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
435 Syrene	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
494 Darnen	Slight	Slight	Slight	Slight	Slight.
497 Hantho	Slight	Slight	Moderate: slope.	Slight	Slight.
508 Wyndmere	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
510 Elmville	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
540 Seelyeville	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
547 Deerwood	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
582 Roliss	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
640 Galchutt	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
642 Clearwater	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
645 Espelie	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
647 Hilaire	Slight	Slight	Slight	Slight	Moderate: droughty.
698 Doran	Slight	Slight	Slight	Slight	Slight.
814*:					
Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight	Slight.
Lindaas	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
821*:					
Doran	Slight	Slight	Slight	Slight	Slight.
Lindaas	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
903B2*:					
Barnes	Slight	Slight	Moderate: slope.	Slight	Slight.
Langhei	Slight	Slight	Moderate: slope.	Slight	Slight.
908*:					
Bearden	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
908*:					
Fargo	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
942C2*:					
Langhei	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Barnes	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
942D2*:					
Langhei	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
957B2*:					
Rothsay	Slight	Slight	Moderate: slope.	Slight	Slight.
Zell	Slight	Slight	Moderate: slope.	Slight	Slight.
969B*:					
Zell	Slight	Slight	Moderate: slope.	Slight	Slight.
Rothsay	Slight	Slight	Moderate: slope.	Slight	Slight.
969C2*:					
Zell	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Rothsay	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
969D2*:					
Zell	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Rothsay	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
987 Rockwell	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1029*. Pits					
1055*:					
Haplaquolls.					
Histosols.					

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1819-----Glyndon	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
1871-----Fargo	Severe: flooding, ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
1872-----Fargo	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
1874-----Lohnes	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
1913C*:					
Wahpeton-----	Severe: flooding.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.	Severe: too clayey.
Cashel-----	Severe: flooding, wetness.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
1916-----Lindaas	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1921-----Foldahl	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
1944-----Perella	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
1948*:					
Fargo-----	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Enloe-----	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1971-----Divide	Slight-----	Slight-----	Slight-----	Slight-----	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
26----------------- Aazdahl	Good	Good	Good	Good	Good	Poor	Fair	Good	Fair	Poor.
33B, 33B2---------- Barnes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
34----------------- Parnell	Fair	Fair	Poor	Poor	Very poor.	Good	Good	Fair	Poor	Good.
46----------------- Borup	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
47----------------- Colvin	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
50----------------- Cashel	Good	Good	Fair	---	---	Poor	Fair	Good	---	Poor.
52----------------- Augsburg	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
56----------------- Fargo	Good	Good	Fair	---	---	Good	Fair	Fair	---	Fair.
57A, 57B----------- Fargo	Good	Good	Fair	---	---	Poor	Fair	Fair	---	Poor.
58----------------- Kittson	Good	Good	Good	Fair	Fair	Fair	Poor	Good	Fair	Fair.
59----------------- Grimstad	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
60----------------- Glyndon	Good	Good	Good	Fair	Poor	Poor	Poor	Good	Fair	Poor.
61----------------- Arveson	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
63----------------- Rockwell	Fair	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
64----------------- Ulen	Fair	Good	Good	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
65----------------- Foxhome	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
66----------------- Flaming	Fair	Fair	Good	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
67A, 67B2---------- Bearden	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
68----------------- Arveson	Fair	Fair	Poor	Fair	Fair	Good	Good	Fair	Fair	Good.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
71 Fossum	Poor	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
93 Bearden	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
107 Winger	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
108 McIntosh	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
157A Wahpeton	Good	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
157B Wahpeton	Good	Good	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
184A Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
184B Hamerly	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
187 Haug	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
236 Vallers	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
245B Lohnes	Fair	Good	Good	Poor	Poor	Poor	Very poor.	Good	Poor	Very poor.
290B, 290B2 Rothsay	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Poor.
293B Swenoda	Fair	Fair	Good	Good	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.
335 Urness	Fair	Fair	Fair	Poor	Very poor.	Good	Good	Fair	Poor	Poor.
343A, 343B2 Wheatville	Good	Good	Good	Fair	Poor	Poor	Fair	Good	Fair	Fair.
344 Quam	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
359 Lamoure	Very poor.	Poor	Fair	Good	Good	Fair	Fair	Poor	Good	Fair.
402B Sioux	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
403 Viking	Poor	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
413 Osakis	Fair	Fair	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
418 Lamoure	Good	Good	Fair	Good	Good	Fair	Fair	Good	Good	Fair.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
425 Donaldson	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
426 Foldahl	Fair	Good	Good	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
429 Northcote	Fair	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor	Fair.
435 Syrene	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
494 Darnen	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
497 Hantho	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
508 Wyndmere	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
510 Elmville	Good	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
540 Seelyeville	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
547 Deerwood	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
582 Roliss	Good	Good	Good	Fair	---	Good	Fair	Good	Fair	Fair.
640 Galchutt	Good	Good	Good	---	---	Fair	Fair	Good	---	Fair.
642 Clearwater	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
645 Espelie	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
647 Hilaire	Fair	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
698 Doran	Good	Good	Good	---	---	Fair	Fair	Good	---	Fair.
814*:										
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Lindaas	Good	Good	Fair	---	---	Good	Good	Good	---	Good.
821*:										
Doran	Good	Good	Good	---	---	Fair	Fair	Good	---	Fair.
Lindaas	Good	Good	Fair	---	---	Good	Good	Good	---	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
903B2*:										
Barnes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Langhei	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
908*:										
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Fargo	Good	Good	Fair	---	---	Poor	Fair	Fair	---	Poor.
942C2*:										
Langhei	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
942D2*:										
Langhei	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
957B2*:										
Rothsay	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Poor.
Zell	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.
969B*:										
Zell	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.
Rothsay	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Poor.
969C2*:										
Zell	Very poor.	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Rothsay	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Poor.
969D2*:										
Zell	Very poor.	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Rothsay	Fair	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Poor.
987 Rockwell	Fair	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
1029*. Pits										

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1055*: Haplaquolls.										
Histosols.										
1819--------------- Glyndon	Good	Good	Good	Fair	Poor	Poor	Poor	Good	Fair	Poor.
1871--------------- Fargo	Very poor.	Poor	Fair	---	---	Poor	Good	Poor	---	Fair.
1872--------------- Fargo	Good	Good	Fair	Fair	---	Poor	Good	Fair	---	Fair.
1874--------------- Lohnes	Fair	Good	Good	Poor	Poor	Poor	Very poor.	Good	Fair	Very poor.
1913C*: Wahpeton----------	Fair	Good	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Cashel------------	Good	Good	Fair	---	---	Poor	Fair	Good	---	Poor.
1916--------------- Lindaas	Good	Good	Fair	---	---	Good	Good	Good	---	Good.
1921--------------- Foldahl	Good	Good	Good	Fair	Poor	Poor	Poor	Good	Fair	Poor.
1944--------------- Perella	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1948*: Fargo-------------	Good	Good	Fair	---	---	Poor	Fair	Fair	---	Poor.
Enloe-------------	Good	Good	Good	---	---	Good	Good	Good	---	Good.
1971--------------- Divide	Fair	Fair	Fair	Good	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
26---------------- Aazdahl	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
33B, 33B2--------- Barnes	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength, frost action.	Slight.
34---------------- Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.	Severe: ponding.
46---------------- Borup	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
47---------------- Colvin	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, frost action.	Moderate: wetness.
50---------------- Cashel	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding.	Severe: too clayey.
52---------------- Augsburg	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
56---------------- Fargo	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
57A, 57B---------- Fargo	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness, too clayey.
58---------------- Kittson	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: frost action.	Slight.
59---------------- Grimstad	Moderate: cutbanks cave, wetness.	Slight---------	Moderate: wetness.	Slight---------	Moderate: frost action.	Slight.
60---------------- Glyndon	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Severe: frost action.	Slight.
61---------------- Arveson	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
63 Rockwell	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
64 Ulen	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: droughty.
65 Foxhome	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
66 Flaming	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: droughty.
67A Bearden	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
67B2 Bearden	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Slight.
68 Arveson	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, frost action.	Severe: ponding.
71 Fossum	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
93 Bearden	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
107 Winger	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
108 McIntosh	Moderate: wetness.	Slight	Moderate: wetness, shrink-swell.	Slight	Severe: frost action.	Slight.
157A, 157B Wahpeton	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, frost action.	Severe: too clayey.
184A Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.	Slight.
184B Hamerly	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
187 Haug	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
236 Vallers	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
245B Lohnes	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
290B Rothsay	Slight	Slight	Slight	Slight	Severe: frost action.	Slight.
290B2 Rothsay	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
293B Swenoda	Moderate: wetness.	Slight	Moderate: wetness, shrink-swell.	Slight	Moderate: frost action.	Slight.
335 Urness	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
343A Wheatville	Severe: cutbanks cave.	Slight	Severe: shrink-swell.	Slight	Severe: frost action.	Slight.
343B2 Wheatville	Severe: cutbanks cave.	Slight	Severe: shrink-swell.	Moderate: slope.	Severe: frost action.	Slight.
344 Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
359 Lamoure	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
402B Sioux	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
403 Viking	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
413 Osakis	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: droughty.
418 Lamoure	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
425 Donaldson	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
426 Foldahl	Severe: cutbanks cave.	Slight	Moderate: shrink-swell, wetness.	Slight	Severe: frost action.	Moderate: droughty.
429 Northcote	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Severe: too clayey.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
435 Syrene	Severe: wetness, cutbanks cave.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness.
494 Darnen	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Moderate: frost action.	Slight.
497 Hantho	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
508 Wyndmere	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
510 Elmville	Severe: cutbanks cave.	Slight	Moderate: wetness, shrink-swell.	Slight	Severe: frost action.	Slight.
540 Seelyeville	Severe: excess humus, ponding.	Severe: flooding, ponding, subsides.	Severe: flooding, ponding, subsides.	Severe: flooding, ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, excess humus.
547 Deerwood	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, excess humus.
582 Roliss	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, frost action.	Moderate: wetness.
640 Galchutt	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
642 Clearwater	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
645 Espelie	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
647 Hilaire	Severe: cutbanks cave.	Slight	Severe: shrink-swell.	Slight	Severe: frost action.	Moderate: droughty.
698 Doran	Moderate: wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
814*: Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
814*:						
Lindaas	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
821*:						
Doran	Moderate: wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
Lindaas	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
903B2*:						
Barnes	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Langhei	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
908*:						
Bearden	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
Fargo	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness, too clayey.
942C2*:						
Langhei	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
Barnes	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
942D2*:						
Langhei	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
957B2*:						
Rothsay	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
Zell	Slight	Slight	Slight	Moderate: slope.	Severe: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
969B*:						
Zell	Slight	Slight	Slight	Slight	Severe: low strength, frost action.	Slight.
Rothsay	Slight	Slight	Slight	Slight	Severe: frost action.	Slight.
969C2*:						
Zell	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Rothsay	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
969D2*:						
Zell	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Rothsay	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
987 Rockwell	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, frost action.	Severe: ponding.
1029*. Pits						
1055*: Haplaquolls.						
Histosols.						
1819 Glyndon	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
1871 Fargo	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding, too clayey.
1872 Fargo	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Severe: too clayey.
1874 Lohnes	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: droughty.
1913C*:						
Wahpeton	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, frost action.	Severe: too clayey.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1913C*:						
Cashel	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding.	Severe: too clayey.
1916 Lindaas	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
1921 Foldahl	Severe: cutbanks cave.	Slight	Moderate: shrink-swell, wetness.	Slight	Severe: frost action.	Slight.
1944 Perella	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Severe: too clayey.
1948*:						
Fargo	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness, too clayey.
Enloe	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1971 Divide	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: low strength, frost action.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
26 Aazdahl	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
33B, 33B2 Barnes	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
34 Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
46 Borup	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: seepage, wetness.	Poor: wetness.
47 Colvin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
50 Cashel	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: too clayey, hard to pack.
52 Augsburg	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
56, 57A, 57B Fargo	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
58 Kittson	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
59 Grimstad	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
60 Glyndon	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
61 Arveson	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
63----------------- Rockwell	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
64----------------- Ulen	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
65----------------- Foxhome	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
66----------------- Flaming	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
67A, 67B2----------- Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack.
68----------------- Arveson	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
71----------------- Fossum	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
93----------------- Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack.
107---------------- Winger	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
108---------------- McIntosh	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
157A, 157B---------- Wahpeton	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
184A--------------- Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
184B--------------- Hamerly	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
187---------------- Haug	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
236 Vallers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
245B Lohnes	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
290B, 290B2 Rothsay	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
293B Swenoda	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
335 Urness	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
343A, 343B2 Wheatville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack.
344 Quam	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
359 Lamoure	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
402B Sioux	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
403 Viking	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
413 Osakis	Severe: poor filter, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
418 Lamoure	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
425 Donaldson	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: wetness, seepage.	Poor: too clayey, hard to pack.
426 Poldahl	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: small stones, wetness.
429 Northcote	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
435 Syrene	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: wetness, seepage.	Poor: seepage, too sandy, wetness.
494 Darnen	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
497 Hantho	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
508 Wyndmere	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy.
510 Elmville	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack.
540 Seelyeville	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding, excess humus.
547 Deerwood	Severe: ponding, poor filter.	Severe: seepage, excess humus.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
582 Roliss	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
640 Galchutt	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
642 Clearwater	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
645 Espelie	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
647 Hilaire	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack.
698 Doran	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
814*:					
Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Lindaas	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
821*:					
Doran	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Lindaas	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
903B2*:					
Barnes	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Langhei	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
908*:					
Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack.
Fargo	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
942C2*:					
Langhei	Moderate: percs slowly, slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Barnes	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
942D2*:					
Langhei	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
957B2*:					
Rothsay	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Zell	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
969B*:					
Zell	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Rothsay	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
969C2*:					
Zell	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Rothsay	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
969D2*:					
Zell	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Rothsay	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
987 Rockwell	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
1029*. Pits					
1055*: Haplaquolls.					
Histosols.					
1819 Glyndon	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
1871 Fargo	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
1872 Fargo	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1874 Lohnes	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
1913C*:					
Wahpeton	Severe: flooding, percs slowly.	Severe: flooding, slope.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1913C*:					
Cashel	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: too clayey, hard to pack.
1916 Lindaas	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1921 Foldahl	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: small stones, wetness.
1944 Perella	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1948*:					
Fargo	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Enloe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
1971 Divide	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
26------------------- Aazdahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
33B, 33B2------------ Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
34------------------- Parnell	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
46------------------- Borup	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
47------------------- Colvin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
50------------------- Cashel	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
52------------------- Augsburg	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
56------------------- Fargo	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
57A, 57B------------- Fargo	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
58------------------- Kittson	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
59------------------- Grimstad	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
60------------------- Glyndon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
61------------------- Arveson	Fair: wetness.	Probable------------	Improbable: too sandy.	Fair: small stones, thin layer.
63------------------- Rockwell	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
64------------------- Ulen	Fair: wetness.	Probable------------	Improbable: too sandy.	Poor: too sandy.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
65 Foxhome	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
66 Flaming	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
67A, 67B2 Bearden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
68 Arveson	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
71 Fossum	Fair: wetness.	Probable	Improbable: too sandy.	Poor: thin layer.
93 Bearden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
107 Winger	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
108 McIntosh	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
157A, 157B Wahpeton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
184A Hamerly	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
184B Hamerly	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
187 Haug	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
236 Vallers	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
245B Lohnes	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
290B, 290B2 Rothsay	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
293B Swenoda	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
335 Urness	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
343A, 343B2 Wheatville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, thin layer.
344 Quam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
359 Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
402B Sioux	Good	Probable	Probable	Poor: small stones, area reclaim.
403 Viking	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
413 Osakis	Good	Probable	Probable	Poor: small stones, area reclaim.
418 Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
425 Donaldson	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
426 Foldahl	Fair: wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
429 Northcote	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
435 Syrene	Fair: wetness.	Probable	Improbable: too sandy.	Poor: small stones.
494 Darnen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
497 Hantho	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
508 Wyndmere	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
510 Elmville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
540 Seelyeville	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
547 Deerwood	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, small stones, wetness.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
582------------------- Roliss	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
640------------------- Galchutt	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
642------------------- Clearwater	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
645------------------- Espelie	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
647------------------- Hilaire	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
698------------------- Doran	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
814*:				
Hamerly---------------	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Lindaas---------------	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
821*:				
Doran-----------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Lindaas---------------	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
903B2*:				
Barnes----------------	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Langhei---------------	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
908*:				
Bearden---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Fargo-----------------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
942C2*:				
Langhei	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
942D2*:				
Langhei	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Barnes	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
957B2*:				
Rothsay	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Zell	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
969B*:				
Zell	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Rothsay	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
969C2*:				
Zell	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Rothsay	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
969D2*:				
Zell	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rothsay	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
987 Rockwell	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1029*. Pits				
1055*:				
Haplaquolls.				
Histosols.				
1819 Glyndon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1871 Fargo	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1872 Fargo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1874 Lohnes	Good	Probable	Improbable: too sandy.	Poor: small stones.
1913C*:				
Wahpeton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cashel	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1916 Lindaas	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1921 Foldahl	Fair: wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
1944 Perella	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1948*:				
Fargo	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Enloe	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1971 Divide	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
26----------------- Aazdahl	Slight----------	Moderate: wetness.	Severe: slow refill.	Deep to water	Erodes easily	Erodes easily.
33B, 33B2--------- Barnes	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
34----------------- Parnell	Slight----------	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, percs slowly.
46----------------- Borup	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness---------	Wetness.
47----------------- Colvin	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
50----------------- Cashel	Slight----------	Severe: wetness, hard to pack.	Severe: slow refill.	Percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
52----------------- Augsburg	Severe: seepage.	Severe: hard to pack, wetness.	Severe: slow refill, cutbanks cave.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
56, 57A, 57B------ Fargo	Slight----------	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
58----------------- Kittson	Moderate: seepage.	Moderate: piping, wetness.	Severe: slow refill.	Frost action---	Wetness---------	Favorable.
59----------------- Grimstad	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Favorable------	Erodes easily, wetness, soil blowing.	Erodes easily.
60----------------- Glyndon	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness---------	Favorable.
61----------------- Arveson	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, too sandy.	Wetness.
63----------------- Rockwell	Severe: seepage.	Moderate: wetness, piping.	Severe: slow refill, cutbanks cave.	Frost action---	Wetness---------	Wetness.
64----------------- Ulen	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, too sandy, soil blowing.	Droughty.
65----------------- Foxhome	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Frost action---	Erodes easily, wetness, soil blowing.	Erodes easily.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
66 Flaming	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, too sandy, soil blowing.	Droughty.
67A Bearden	Moderate: seepage.	Moderate: piping, hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
67B2 Bearden	Moderate: seepage, slope.	Moderate: piping, hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
68 Arveson	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, too sandy.	Wetness.
71 Fossum	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, too sandy, soil blowing.	Wetness, droughty.
93 Bearden	Moderate: seepage.	Moderate: piping, hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
107 Winger	Moderate: seepage.	Severe: piping, wetness.	Severe: slow refill.	Frost action	Wetness	Wetness.
108 McIntosh	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
157A Wahpeton	Moderate: seepage.	Severe: hard to pack.	Severe: no water.	Deep to water	Favorable	Favorable.
157B Wahpeton	Moderate: seepage, slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Favorable	Favorable.
184A Hamerly	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
184B Hamerly	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action, slope.	Erodes easily, wetness.	Erodes easily.
187 Haug	Moderate: seepage.	Severe: piping, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding, soil blowing.	Wetness.
236 Vallers	Slight	Severe: wetness.	Severe: slow refill.	Frost action	Wetness	Wetness.
245B Lohnes	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
290B, 290B2------- Rothsay	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
293B-------------- Swenoda	Severe: seepage.	Severe: piping.	Severe: no water.	Favorable------	Erodes easily, wetness.	Erodes easily.
335--------------- Urness	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
343A-------------- Wheatville	Severe: seepage.	Severe: hard to pack.	Severe: slow refill, cutbanks cave.	Percs slowly, frost action.	Wetness, percs slowly.	Percs slowly.
343B2------------- Wheatville	Severe: seepage.	Severe: hard to pack.	Severe: slow refill, cutbanks cave.	Percs slowly, frost action, slope.	Wetness, soil blowing, percs slowly.	Percs slowly.
344--------------- Quam	Slight---------	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Wetness, erodes easily.
359--------------- Lamoure	Moderate: seepage.	Severe: hard to pack, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness--------	Wetness.
402B-------------- Sioux	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy------	Droughty.
403--------------- Viking	Slight---------	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly---	Wetness, percs slowly.	Wetness, percs slowly.
413--------------- Osakis	Severe: seepage.	Severe: seepage.	Moderate: deep to water, slow refill, cutbanks cave.	Deep to water	Too sandy, soil blowing.	Droughty.
418--------------- Lamoure	Moderate: seepage.	Severe: hard to pack, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness--------	Wetness.
425--------------- Donaldson	Severe: seepage.	Severe: hard to pack.	Severe: slow refill, cutbanks cave.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Percs slowly.
426--------------- Foldahl	Severe: seepage.	Severe: piping.	Severe: slow refill.	Frost action---	Soil blowing, wetness, erodes easily.	Erodes easily, droughty.
429--------------- Northcote	Slight---------	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
435--------------- Syrene	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, too sandy, soil blowing.	Wetness, droughty.
494--------------- Darnen	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Favorable------	Erodes easily, wetness.	Erodes easily.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
497 Hantho	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
508 Wyndmere	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, too sandy, soil blowing.	Favorable.
510 Elmville	Severe: seepage.	Moderate: hard to pack, wetness.	Severe: slow refill, cutbanks cave.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Percs slowly.
540 Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides.	Ponding	Wetness.
547 Deerwood	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, subsides, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness.
582 Roliss	Moderate: seepage.	Severe: wetness, piping.	Severe: slow refill.	Frost action	Wetness	Wetness.
640 Galchutt	Moderate: seepage.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
642 Clearwater	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Wetness, percs slowly.
645 Espelie	Severe: seepage.	Severe: wetness.	Severe: slow refill, cutbanks cave.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Wetness, percs slowly, droughty.
647 Hilaire	Severe: seepage.	Severe: hard to pack.	Severe: slow refill, cutbanks cave.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Droughty, percs slowly.
698 Doran	Slight	Moderate: piping, wetness.	Severe: slow refill.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
814*:						
Hamerly	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
Lindaas	Moderate: seepage.	Severe: thin layer, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
821*:						
Doran	Slight	Moderate: piping, wetness.	Severe: slow refill.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Lindaas	Moderate: seepage.	Severe: thin layer, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
903B2*:						
Barnes	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Langhei	Moderate: slope, seepage.	Moderate: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
908*:						
Bearden	Moderate: seepage.	Moderate: piping, hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
Fargo	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
942C2*, 942D2*:						
Langhei	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Barnes	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
957B2*:						
Rothsay	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Zell	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
969B*:						
Zell	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Rothsay	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
969C2*, 969D2*:						
Zell	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Rothsay	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
987 Rockwell	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, frost action.	Ponding, soil blowing.	Wetness.
1029*. Pits						
1055*: Haplaquolls.						
Histosols.						

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
1819 Glyndon	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness	Favorable.
1871 Fargo	Slight	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, percs slowly.
1872 Fargo	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness	Wetness, percs slowly.
1874 Lohnes	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Too sandy, soil blowing.	Droughty.
1913C*: Wahpeton	Moderate: seepage, slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Favorable	Favorable.
Cashel	Slight	Severe: wetness, hard to pack.	Severe: slow refill.	Percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
1916 Lindaas	Moderate: seepage.	Severe: thin layer, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
1921 Foldahl	Severe: seepage.	Severe: piping.	Severe: slow refill.	Frost action	Soil blowing, wetness, erodes easily.	Erodes easily.
1944 Perella	Slight	Severe: piping.	Severe: slow refill.	Percs slowly, frost action.	Wetness	Percs slowly.
1948*: Fargo	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
Enloe	Slight	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, percs slowly.
1971 Divide	Severe: seepage.	Severe: seepage.	Severe: cutbanks cave.	Cutbanks cave	Wetness, too sandy.	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
26 Aazdahl	0-12	Clay loam	CL	A-7, A-6	0-3	95-100	90-100	85-100	75-90	35-50	15-30
	12-18	Clay loam, silty clay loam.	CL	A-7, A-6	0-3	95-100	90-100	85-95	70-80	35-50	15-30
	18-60	Clay loam, silty clay loam, loam.	CL	A-7, A-6	0-3	95-100	90-100	85-95	70-80	35-50	15-30
33B, 33B2 Barnes	0-10	Loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	80-100	35-90	20-40	5-20
	10-20	Loam, sandy clay loam, clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	20-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
34 Parnell	0-24	Silt loam, loam	OL, ML	A-4	0	100	100	90-100	70-90	25-40	2-10
	24-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
46 Borup	0-10	Loam	ML	A-4	0	100	100	95-100	70-95	20-34	NP-7
	10-25	Very fine sandy loam, loamy very fine sand, loam.	ML	A-4	0	100	100	90-100	60-95	<30	NP-5
	25-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML	A-4	0	100	100	85-100	50-90	<30	NP-5
47 Colvin	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	9-24	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	10-30
	24-60	Loam, silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
50 Cashel	0-9	Silty clay	CH, CL	A-7	0	100	100	95-100	85-100	45-70	20-40
	9-60	Silty clay, clay, silty clay loam.	CH, CL, MH	A-7	0	95-100	95-100	95-100	85-100	45-70	20-40
52 Augsburg	0-13	Very fine sandy loam.	ML, CL, OL, CL-ML	A-4, A-6	0	100	100	95-100	50-90	15-40	NP-15
	13-20	Loam, very fine sandy loam, silt loam.	ML	A-4	0	100	100	95-100	50-90	20-40	NP-10
	20-27	Loamy very fine sand, very fine sandy loam, loam.	ML	A-4	0	100	100	95-100	50-85	20-40	NP-10
	27-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	50-90	35-55
56 Fargo	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	11-25
	10-28	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	28-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
57A, 57B Fargo	0-11	Silty clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	11-20	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	20-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
58 Kittson	0-14	Loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-95	50-75	20-40	5-20
	14-18	Loam, fine sandy loam, sandy loam.	CL, SC	A-6	0-5	90-100	65-100	60-90	40-75	20-40	10-20
	18-60	Loam, clay loam	CL	A-6	0-2	95-100	85-98	80-90	50-75	20-40	10-20
59 Grimstad	0-18	Sandy loam	SM, SM-SC	A-4, A-2	0	100	100	80-100	15-50	15-30	NP-7
	18-32	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-90	5-35	<25	NP-4
	32-60	Silty clay loam, fine sandy loam, loam.	SC, CL, SM-SC, CL-ML	A-4, A-6	0-3	95-100	85-100	70-90	40-85	15-40	5-20
60 Glyndon	0-9	Very fine sandy loam.	ML	A-4	0	100	100	95-100	70-95	20-40	NP-10
	9-23	Silt loam, very fine sandy loam, sandy clay loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	60-95	20-30	NP-10
	23-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML, SM, SC, CL	A-4	0	100	100	85-100	35-75	10-30	NP-10
61 Arveson	0-11	Loam	ML	A-4	0-1	100	95-100	85-90	50-80	20-40	NP-10
	11-35	Fine sandy loam, sandy loam, loam.	SM, SM-SC	A-4	0	100	95-100	60-85	35-50	<20	NP-5
	35-60	Fine sand, loamy sand, sandy loam.	SP-SM, SM, SM-SC	A-3, A-2, A-4	0	100	95-100	50-80	5-45	<20	NP-5
63 Rockwell	0-10	Loam	OL, ML	A-4	0	100	95-100	85-95	50-75	20-40	NP-10
	10-19	Fine sandy loam, sandy loam, loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	60-85	35-55	15-25	1-7
	19-24	Fine sand, sand, loamy fine sand.	SM	A-2	0	100	95-100	65-80	20-35	---	NP
	24-60	Silt loam, loam, silty clay loam.	CL, CL-ML, SC, SM-SC	A-6, A-4	0-1	95-100	90-100	70-90	40-85	15-40	5-20
64 Ulen	0-11	Fine sandy loam	SM, SM-SC, SC	A-4	0	100	100	80-100	35-50	<25	NP-8
	11-23	Loamy fine sand, fine sand.	SM	A-2	0	100	95-100	70-95	12-35	---	NP
	23-60	Fine sand	SP-SM, SM	A-3, A-2	0	100	95-100	80-100	5-35	---	NP
65 Foxhome	0-14	Sandy loam	SM	A-4	0-2	95-100	90-100	75-90	35-50	<30	NP-5
	14-18	Loamy sand, sandy loam, loam.	SM, SP-SM	A-2, A-4	0-2	95-100	85-100	55-80	10-50	20-30	NP-5
	18-30	Very gravelly sand, very gravelly coarse sand, very gravelly loamy sand.	SP, SP-SM, GP, GP-GM	A-1	2-5	50-75	40-60	20-50	0-10	---	NP
	30-60	Loam, clay loam, silt loam.	ML, CL, CL-ML	A-4, A-6	1-5	90-100	85-100	75-90	50-80	20-40	1-15
66 Flaming	0-9	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	75-90	5-30	---	NP
	9-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	75-90	5-30	---	NP

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
67A, 67B2-------- Bearden	0-10	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	20-40	5-20
	10-26	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
	26-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
68--------------- Arveson	0-14	Loam-------------	ML	A-4	0	100	95-100	85-90	50-80	20-40	NP-10
	14-26	Fine sandy loam, sandy loam, loam.	SM, SM-SC	A-4	0	100	95-100	60-85	35-50	<20	NP-5
	26-60	Fine sand, loamy sand, sandy loam.	SP-SM, SM, SM-SC	A-3, A-2, A-4	0	100	95-100	50-80	5-45	<20	NP-5
71--------------- Fossum	0-12	Loamy fine sand	SM, SP-SM	A-2	0	100	100	60-80	10-35	<20	NP-4
	12-20	Loamy fine sand, sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	100	60-80	5-30	---	NP
	20-60	Sand, fine sand	SP-SM, SM	A-3, A-2	0	95-100	95-100	60-80	5-20	---	NP
93--------------- Bearden	0-9	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	80-95	25-55	10-30
	9-33	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
	33-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
107-------------- Winger	0-10	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	20-40	2-15
	10-32	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	20-40	2-15
	32-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6, A-7	0-10	90-100	85-97	75-95	50-75	20-45	3-25
108-------------- McIntosh	0-7	Silt loam--------	CL-ML, CL, ML	A-4, A-7, A-6	0	100	100	85-100	70-95	20-50	3-25
	7-25	Silt loam, silty clay loam, loam.	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	70-90	20-40	2-15
	25-60	Loam, clay loam	CL, ML	A-6, A-4	0-5	95-100	90-100	80-95	60-80	30-40	7-15
157A, 157B------- Wahpeton	0-27	Clay-------------	CH	A-7	0	100	100	95-100	80-95	50-75	25-50
	27-60	Clay, silty clay	CH, CL	A-7, A-6	0	100	100	95-100	80-95	35-75	25-50
184A------------- Hamerly	0-9	Clay loam--------	CL	A-6, A-7	0-5	95-100	90-100	80-95	75-95	30-45	10-25
	9-25	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
184B------------- Hamerly	0-9	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-20	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-75	20-40	5-20
	20-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-75	20-40	5-20
187-------------- Haug	0-14	Muck-------------	PT	A-8	---	---	---	---	---	---	---
	14-20	Mucky sandy loam, fine sandy loam, loam.	OL, ML, CL, SM	A-4, A-6	0-3	95-100	90-100	70-85	35-65	15-40	1-15
	20-60	Loam, silt loam, fine sandy loam.	ML, CL, SM, SC	A-4, A-6	0-3	95-100	70-100	60-95	35-65	15-40	1-15

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
236-------------- Vallers	0-15	Loam-------------	OL, ML	A-4	0	95-100	90-100	80-90	50-80	30-40	4-10
	15-25	Clay loam, silty clay loam, loam.	CL	A-6	0	95-100	90-97	80-95	50-80	30-40	11-20
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-97	85-95	60-75	20-40	5-20
245B------------- Lohnes	0-16	Loamy sand, loamy coarse sand.	SM, SP-SM	A-2, A-1	0	100	100	45-65	10-25	---	NP
	16-60	Gravelly loamy sand, gravelly coarse sand, loamy sand.	SM, SP-SM, SP	A-2, A-1, A-3	0	80-100	65-100	35-60	2-20	---	NP
290B, 290B2------ Rothsay	0-11	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-100	20-40	NP-10
	11-16	Silt loam, very fine sandy loam.	ML	A-4	0	95-100	95-100	90-100	80-100	20-40	NP-10
	16-60	Silt loam, very fine sandy loam.	ML	A-4	0	95-100	95-100	90-100	80-90	20-40	NP-10
293B------------- Swenoda	0-13	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	13-21	Fine sandy loam, sandy loam.	SM-SC, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-85	30-55	20-30	NP-10
	21-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	95-100	75-100	50-95	25-45	5-20
335-------------- Urness	0-10	Mucky silt loam	OL, CL, CL-ML	A-8, A-4, A-6, A-7	0	100	100	90-100	70-95	20-50	3-20
	10-48	Mucky silt loam, mucky silty clay loam, silty clay loam.	ML, CL, CL-ML, OL	A-4, A-6, A-7	0	95-100	90-100	85-100	70-95	20-50	3-30
	48-60	Clay loam, silt loam, loam.	CL, ML	A-6, A-7	0-2	95-100	85-100	75-100	65-95	35-50	11-20
343A------------- Wheatville	0-10	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	90-100	50-95	15-35	NP-10
	10-37	Very fine sandy loam, silt loam, loamy very fine sand.	ML, CL, CL-ML	A-4	0	100	100	85-100	50-95	15-35	NP-10
	37-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-80	15-45
343B2------------ Wheatville	0-10	Very fine sandy loam.	ML	A-4	0	100	100	95-100	50-100	---	NP
	10-37	Very fine sandy loam, silt loam, loamy very fine sand.	ML, CL, CL-ML	A-4	0	100	100	85-100	50-95	15-35	NP-10
	37-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-80	15-45
344-------------- Quam	0-10	Silt loam--------	OL, ML	A-7, A-4, A-6, A-5	0	100	100	80-100	70-95	30-50	5-20
	10-32	Silty clay loam, silt loam, clay loam.	CL, ML	A-7, A-6, A-4	0	100	100	80-100	70-95	30-50	5-25
	32-60	Clay loam, silty clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	90-100	85-95	70-90	20-50	5-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
359 Lamoure	0-34	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	85-100	45-70	20-35
	34-60	Silty clay loam, silt loam.	CL, CH, MH, ML	A-7	0	100	100	90-100	85-100	40-70	15-35
402B Sioux	0-8	Sandy loam	SM	A-4	0-5	95-100	85-100	60-85	35-45	20-30	NP-7
	8-11	Gravelly loam, gravelly sandy loam, gravelly loamy coarse sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	11-60	Gravelly very coarse sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
403 Viking	0-12	Silty clay, clay	CH, CL	A-7	0-5	90-97	90-97	90-95	80-95	40-85	20-50
	12-27	Clay, clay loam, silty clay.	CH, CL	A-7	0-5	90-97	90-97	90-95	80-95	40-85	20-50
	27-60	Clay	CH	A-7	0-5	90-97	90-97	90-95	80-95	60-85	30-50
413 Osakis	0-8	Sandy loam	SM, SM-SC	A-4, A-2	0	95-100	85-100	50-70	25-40	<25	NP-7
	8-19	Loam, sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2	0	95-100	85-100	55-90	25-70	20-35	1-8
	19-60	Coarse sand, gravelly sand, very gravelly loamy sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	30-95	20-85	10-50	0-10	<20	NP
418 Lamoure	0-32	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	85-100	45-70	20-35
	32-60	Silty clay loam, silt loam, loam.	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-100	30-50	10-20
425 Donaldson	0-9	Very fine sandy loam.	SM, ML	A-4	0	100	100	95-100	35-60	<35	1-5
	9-19	Loamy very fine sand, very fine sandy loam, loam.	SM, ML	A-4	0	100	100	95-100	35-60	<35	1-10
	19-30	Loamy very fine sand, very fine sandy loam, very fine sand.	SM	A-4, A-2	0	100	100	95-100	20-50	<30	NP-5
	30-60	Clay, silty clay, silty clay loam.	CH	A-7	0	100	95-100	90-100	85-100	60-80	30-50
426 Foldahl	0-10	Loamy fine sand	SM, SP-SM	A-2	0	100	95-100	70-85	12-35	---	NP
	10-22	Fine sand, loamy fine sand, sand.	SP-SM, SM	A-2, A-3	0-3	95-100	90-100	70-85	5-35	---	NP
	22-60	Loam, clay loam, sandy loam.	CL-ML, CL, SM-SC, SC	A-4, A-6	1-5	95-100	75-95	70-90	40-85	15-40	5-20
429 Northcote	0-9	Clay	CH	A-7	0	100	100	95-100	95-100	65-80	35-45
	9-20	Clay	CH	A-7	0	100	100	95-100	90-100	65-85	30-50
	20-60	Clay	CH	A-7	0	100	100	95-100	90-100	65-85	40-60

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
435 Syrene	0-9	Sandy loam	SM, SC, SM-SC	A-4	0-3	95-100	85-100	55-70	35-50	15-35	NP-10
	9-18	Loam, sandy loam, sandy clay loam.	SM, ML	A-4	0-3	95-100	85-100	55-75	35-65	20-40	1-10
	18-60	Stratified loamy fine sand to gravelly coarse sand.	SP-SM, SP	A-3, A-1, A-2	2-5	75-95	55-85	30-60	0-10	---	NP
494 Darnen	0-24	Silt loam	OL, ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-35	2-10
	24-35	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-90	20-45	5-25
	35-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	90-100	90-100	80-95	60-85	20-45	5-25
497 Hantho	0-18	Silt loam	ML	A-4	0	100	95-100	90-100	85-100	20-40	NP-10
	18-32	Silt loam, very fine sandy loam.	ML	A-4	0	100	95-100	90-100	80-100	20-40	NP-10
	32-60	Silt loam, very fine sandy loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	90-100	80-100	20-45	NP-20
508 Wyndmere	0-11	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	60-80	30-55	---	NP
	11-27	Sandy loam, fine sandy loam.	SM, ML	A-2, A-4	0	100	100	60-80	30-55	---	NP
	27-60	Fine sand, loamy fine sand, fine sandy loam.	SM, ML	A-2, A-4	0	100	100	60-85	20-55	---	NP
510 Elmville	0-15	Very fine sandy loam.	ML, SM	A-4	0	100	100	60-90	35-55	15-30	NP-7
	15-34	Loamy very fine sand, very fine sand, loamy fine sand.	SM, ML	A-4, A-2	0	100	100	60-85	20-55	<20	NP-4
	34-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-65	15-40
540 Seelyeville	0-4	Muck	PT	A-8	0	---	---	---	---	---	---
	4-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
547 Deerwood	0-12	Muck	PT	A-8	0	---	---	---	---	---	---
	12-28	Fine sand, loamy fine sand, fine sandy loam.	SM, SP-SM	A-2, A-4	0-5	95-100	90-100	50-75	12-50	<20	NP-4
	28-60	Fine sand, sand, gravelly sand.	SM, SP, SP-SM	A-2, A-3, A-1	0-5	75-100	55-100	35-70	1-35	---	NP
582 Roliss	0-10	Clay loam	CL, CL-ML	A-4, A-6, A-7	0	95-100	80-100	80-100	60-90	20-50	5-30
	10-17	Loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	95-100	80-100	80-90	60-80	20-50	10-30
	17-60	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0	95-100	80-100	80-95	60-80	20-50	5-30
640 Galchutt	0-10	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	NP-20
	10-13	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	60-95	20-40	NP-20
	13-60	Silty clay, clay	CH	A-7	0	95-100	90-100	85-100	80-100	50-95	25-60

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
642 Clearwater	0-9	Sandy clay loam	SM-SC, SM, ML, CL-ML	A-4, A-6	0	95-100	90-97	65-85	45-65	20-35	NP-11
	9-17	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	95-100	90-97	80-95	70-95	40-80	20-50
	17-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	95-100	90-100	80-97	75-95	40-80	20-50
645 Espelie	0-11	Fine sandy loam	SM, ML, SC, CL	A-4, A-2	0	95-100	85-100	60-85	30-65	<25	NP-8
	11-27	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-4, A-1	0-5	85-100	60-100	30-80	10-40	<20	NP-4
	27-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	1-3	90-100	85-100	80-100	70-100	40-65	20-40
647 Hilaire	0-10	Loamy fine sand	SM, ML, SM-SC, CL-ML	A-2, A-4	0	90-100	75-100	50-85	20-55	<20	NP-7
	10-26	Loamy sand, loamy fine sand, sand.	SM, SP-SM	A-1, A-2	0-5	85-100	65-100	30-70	10-30	<20	NP-4
	26-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	1-3	95-100	85-100	75-95	65-90	40-70	20-45
698 Doran	0-9	Clay loam	CH, CL	A-6, A-7	0	100	100	95-100	65-95	25-60	11-35
	9-22	Clay, clay loam	CH, CL	A-7, A-6	0	100	95-100	90-100	70-95	25-75	11-50
	22-60	Clay loam, loam	CL	A-6, A-7	0-3	95-100	85-100	70-100	50-80	25-50	11-30
814*: Hamerly	0-10	Silty clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	75-95	30-45	10-25
	10-17	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	17-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
Lindaas	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	75-95	30-50	11-25
	9-27	Silty clay, clay	CH	A-7	0	100	100	95-100	80-95	50-70	25-45
	27-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	55-95	20-40	5-20
821*: Doran	0-9	Clay loam	CH, CL	A-6, A-7	0	100	100	95-100	65-95	25-60	11-35
	9-19	Clay, clay loam, silty clay.	CH, CL	A-7, A-6	0	100	95-100	90-100	70-95	25-75	11-50
	19-60	Clay loam, loam	CL	A-6, A-7	0-3	95-100	85-100	70-100	50-80	25-50	11-30
Lindaas	0-12	Silt loam	CL	A-6, A-7	0	100	100	95-100	75-95	30-50	11-25
	12-30	Silty clay, clay	CH	A-7	0	100	100	95-100	80-95	50-70	25-45
	30-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	55-95	20-40	5-20
903B2*: Barnes	0-10	Loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	80-100	35-90	20-40	5-20
	10-20	Loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	20-60	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
903B2*:											
Langhei	0-8	Loam	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	8-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
908*:											
Bearden	0-13	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	80-95	25-55	10-30
	13-22	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
	22-60	Silt loam, silty clay loam, loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
Fargo	0-12	Silty clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	12-21	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	21-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
942C2*, 942D2*:											
Langhei	0-6	Loam	CL-ML, CL	A-4, A-6	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	6-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-90	60-80	20-40	5-25
Barnes	0-8	Loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	80-100	35-90	20-40	5-20
	8-19	Loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	19-60	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
957B2*:											
Rothsay	0-10	Silt loam	ML	A-4	0	95-100	95-100	90-100	85-100	20-40	NP-10
	10-20	Silt loam, very fine sandy loam, loam.	ML	A-4	0	95-100	95-100	90-100	80-100	20-40	NP-10
	20-60	Silt loam, loam, very fine sandy loam.	ML	A-4	0	95-100	95-100	90-100	80-90	20-40	NP-10
Zell	0-8	Silt loam	CL, ML	A-4, A-6	0	100	95-100	85-100	80-100	30-40	5-15
	8-28	Silt loam, very fine sandy loam, loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	85-100	70-100	25-40	5-15
	28-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML	A-4	0	100	95-100	85-100	60-100	<30	NP-7
969B*, 969C2*, 969D2*:											
Zell	0-7	Silt loam	CL, ML	A-4, A-6	0	100	95-100	85-100	80-100	30-40	5-15
	7-36	Silt loam, very fine sandy loam, loam.	CL, ML, CL-ML	A-4, A-6	0	100	95-100	85-100	70-100	25-40	5-15
	36-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML	A-4	0	100	95-100	85-100	60-100	<30	NP-7
Rothsay	0-11	Silt loam	ML	A-4	0	95-100	95-100	90-100	85-100	20-40	NP-10
	11-16	Silt loam, very fine sandy loam, loam.	ML	A-4	0	95-100	95-100	90-100	80-100	20-40	NP-10
	16-60	Silt loam, loam, very fine sandy loam.	ML	A-4	0	95-100	95-100	90-100	80-90	20-40	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
987------------- Rockwell	0-12	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-4	0	100	95-100	70-85	40-55	15-25	1-7
	12-19	Fine sandy loam, sandy loam, loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	60-85	35-55	15-25	1-7
	19-26	Fine sand, sand, loamy fine sand.	SM	A-2	0	100	95-100	65-80	20-35	---	NP
	26-60	Silt loam, loam, clay loam.	CL, CL-ML, SC, SM-SC	A-6, A-4	0-1	95-100	90-100	70-90	40-85	15-40	5-20
1029*. Pits											
1055*: Haplaquolls.											
Histosols.											
1819------------- Glyndon	0-18	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-95	30-45	10-25
	18-24	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	60-95	20-30	NP-10
	24-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML, SM, SC, CL	A-4	0	100	100	85-100	35-75	10-30	NP-10
1871------------- Fargo	0-10	Silty clay-------	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	10-18	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	18-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
1872------------- Fargo	0-13	Silty clay-------	CH	A-7	0	100	100	95-100	85-100	50-75	25-45
	13-30	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-45
	30-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-100	25-50	10-25
1874------------- Lohnes	0-12	Sandy loam-------	SM, SM-SC	A-2, A-4	0	100	100	60-70	30-40	<20	NP-5
	12-60	Coarse sand, loamy coarse sand, loamy sand.	SM, SP-SM, SP	A-2, A-1, A-3	0	80-100	55-100	35-60	2-20	---	NP
1913C*: Wahpeton--------	0-17	Silty clay-------	CH	A-7	0	100	100	95-100	80-95	50-75	25-50
	17-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	95-100	80-95	35-75	25-50
Cashel----------	0-14	Silty clay-------	CH, CL	A-7	0	100	100	95-100	85-100	45-70	20-40
	14-60	Silty clay, clay, silty clay loam.	CH, CL, MH	A-7	0	95-100	95-100	95-100	85-100	45-70	20-40
1916------------- Lindaas	0-9	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	75-95	30-50	11-25
	9-27	Silty clay, clay	CH	A-7	0	100	100	95-100	80-95	50-70	25-45
	27-60	Silt loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	55-95	20-40	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1921 Foldahl	0-10	Very fine sandy loam.	SM, ML	A-4	0	100	95-100	70-85	35-60	<20	NP-4
	10-22	Fine sand, loamy fine sand, sand.	SP-SM, SM	A-2, A-3	0-3	95-100	90-100	70-85	5-35	---	NP
	22-60	Loam, clay loam, sandy loam.	CL-ML, CL, SM-SC, SC	A-4, A-6	1-5	95-100	75-95	70-90	40-85	15-40	5-20
1944 Perella	0-9	Silty clay	CL, CH	A-7	0	100	100	95-100	90-95	40-60	20-40
	9-19	Silt loam, silty clay loam, silty clay.	CL, CL-ML, CH	A-4, A-7, A-6	0	100	95-100	95-100	80-100	25-60	5-40
	19-60	Silt loam, silty clay loam, silt.	CL, CL-ML	A-4, A-7, A-6	0	100	95-100	95-100	80-100	25-45	5-25
1948*: Fargo	0-10	Silty clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	10-22	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	22-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
Enloe	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-50	15-30
	14-33	Silty clay, clay	CH	A-7	0	100	100	95-100	75-95	50-75	25-45
	33-60	Silty clay, clay, clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-75	20-45
1971 Divide	0-9	Loam	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-85	25-40	5-20
	9-23	Loam, clay loam, gravelly loam.	CL, CL-ML	A-4, A-6	0-3	95-100	80-100	60-90	55-80	20-40	5-20
	23-60	Stratified sand to gravelly sand.	GM, SM, GP-GM, SP-SM	A-1	0-5	25-75	15-65	10-40	5-25	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
26----------------	0-12	27-35	1.30-1.50	0.6-2.0	0.17-0.19	6.6-7.3	<2	Moderate	0.24	5	6	4-6
Aazdahl	12-18	27-35	1.40-1.60	0.2-0.6	0.17-0.19	6.6-7.8	<2	Moderate	0.37			
	18-60	24-35	1.50-1.65	0.2-0.6	0.14-0.17	7.4-8.4	<2	Moderate	0.37			
33B, 33B2---------	0-10	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	<2	Low--------	0.28	5	6	2-5
Barnes	10-20	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	<2	Low--------	0.28			
	20-60	18-30	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	<4	Low--------	0.37			
34----------------	0-24	24-27	1.25-1.35	0.6-2.0	0.22-0.24	6.1-7.8	<2	Low--------	0.28	5	6	6-10
Parnell	24-60	35-60	1.20-1.30	0.06-0.2	0.13-0.19	6.6-7.8	<2	High-------	0.28			
46----------------	0-10	15-27	1.20-1.40	2.0-6.0	0.20-0.23	7.4-8.4	<4	Low--------	0.28	5	4L	4-8
Borup	10-25	10-18	1.30-1.50	2.0-6.0	0.17-0.20	7.4-8.4	<4	Low--------	0.28			
	25-60	5-18	1.35-1.65	2.0-20	0.15-0.19	7.4-8.4	2-8	Low--------	0.28			
47----------------	0-9	27-34	1.20-1.50	0.2-0.6	0.20-0.22	7.4-9.0	<2	Moderate	0.32	5	4L	4-7
Colvin	9-24	18-34	1.20-1.50	0.06-0.6	0.16-0.20	7.4-9.0	<2	Moderate	0.32			
	24-60	18-34	1.30-1.50	0.06-2.0	0.15-0.20	7.4-9.0	<2	Moderate	0.32			
50----------------	0-9	40-60	1.20-1.40	0.06-0.6	0.15-0.18	7.4-8.4	<2	High-------	0.32	5	4	4-8
Cashel	9-60	35-60	1.30-1.70	0.06-0.6	0.13-0.17	7.4-8.4	<2	High-------	0.32			
52----------------	0-13	10-27	1.20-1.40	0.6-6.0	0.20-0.23	7.4-8.4	<2	Low--------	0.28	5	4L	4-6
Augsburg	13-20	5-18	1.30-1.50	2.0-6.0	0.20-0.23	7.4-8.4	<2	Low--------	0.28			
	20-27	5-18	1.40-1.60	2.0-6.0	0.17-0.22	7.4-8.4	2-4	Low--------	0.28			
	27-60	35-85	1.10-1.40	<0.2	0.10-0.14	7.4-8.4	<2	High-------	0.28			
56----------------	0-10	27-39	1.10-1.30	0.06-0.2	0.18-0.23	6.6-7.8	<2	Moderate	0.32	5	7	4-10
Fargo	10-28	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.6-7.8	<2	High-------	0.32			
	28-60	40-60	1.20-1.50	0.06-0.2	0.14-0.17	7.9-8.4	<2	High-------	0.32			
57A, 57B----------	0-11	40-60	1.10-1.30	0.06-0.2	0.15-0.18	6.6-7.8	<2	High-------	0.32	5	4	4-10
Fargo	11-20	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.6-7.8	<2	High-------	0.32			
	20-60	40-60	1.20-1.50	0.06-0.2	0.14-0.17	7.9-8.4	<2	High-------	0.32			
58----------------	0-14	10-27	1.30-1.45	0.6-2.0	0.20-0.22	6.6-7.8	<2	Low--------	0.24	5	5	4-6
Kittson	14-18	18-30	1.35-1.55	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low--------	0.32			
	18-60	18-30	1.40-1.65	0.2-2.0	0.15-0.18	7.4-8.4	<2	Moderate	0.32			
59----------------	0-18	10-18	1.30-1.45	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low--------	0.20	5	3	2-4
Grimstad	18-32	2-15	1.45-1.60	6.0-20	0.08-0.14	7.4-9.0	<2	Low--------	0.20			
	32-60	10-30	1.50-1.65	0.6-2.0	0.11-0.19	7.4-9.0	<2	Low--------	0.37			
60----------------	0-9	15-27	1.20-1.40	0.6-2.0	0.20-0.23	7.4-9.0	<4	Low--------	0.28	4	4L	3-7
Glyndon	9-23	10-18	1.30-1.50	0.6-6.0	0.17-0.20	7.4-9.0	<4	Low--------	0.28			
	23-60	5-18	1.35-1.65	2.0-6.0	0.15-0.19	7.4-9.0	<4	Low--------	0.28			
61----------------	0-11	20-35	1.20-1.35	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low--------	0.24	4	4L	5-8
Arveson	11-35	10-27	1.40-1.55	0.6-6.0	0.15-0.17	7.4-8.4	<2	Low--------	0.24			
	35-60	5-20	1.50-1.65	2.0-20	0.05-0.15	7.4-8.4	<2	Low--------	0.17			
63----------------	0-10	20-30	1.20-1.45	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.24	5	4L	4-8
Rockwell	10-19	5-30	1.35-1.50	2.0-6.0	0.15-0.17	7.9-8.4	<2	Low--------	0.24			
	19-24	3-10	1.40-1.60	6.0-20	0.05-0.07	7.4-7.8	<2	Low--------	0.24			
	24-60	15-30	1.40-1.60	0.2-2.0	0.18-0.22	7.4-7.8	<2	Low--------	0.24			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
64	0-11	8-20	1.30-1.50	2.0-6.0	0.13-0.18	7.9-8.4	<4	Low	0.17	4	3	2-5
Ulen	11-23	5-12	1.45-1.65	6.0-20	0.06-0.10	7.9-8.4	<4	Low	0.17			
	23-60	1-7	1.50-1.70	6.0-20	0.06-0.08	7.9-8.4	<4	Low	0.17			
65	0-14	10-20	1.35-1.50	2.0-6.0	0.14-0.18	6.6-7.3	<2	Low	0.20	3	3	3-7
Foxhome	14-18	10-25	1.35-1.50	2.0-20	0.10-0.15	6.6-7.3	<2	Low	0.20			
	18-30	5-15	1.50-1.70	6.0-20	0.03-0.05	7.4-7.8	<2	Low	0.10			
	30-60	12-35	1.40-1.70	0.6-2.0	0.15-0.21	7.4-8.4	<2	Low	0.37			
66	0-9	2-10	1.40-1.55	6.0-20	0.11-0.13	5.6-7.3	<2	Low	0.17	5	2	2-4
Flaming	9-60	2-10	1.50-1.70	6.0-20	0.06-0.10	5.6-8.4	<2	Low	0.17			
67A, 67B2	0-10	10-26	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<4	Moderate	0.28	5	4L	3-7
Bearden	10-26	18-34	1.30-1.50	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate	0.28			
	26-60	18-34	1.30-1.80	0.06-2.0	0.16-0.22	7.4-8.4	<8	Moderate	0.43			
68	0-14	20-35	1.20-1.35	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low	0.24	4	4L	6-10
Arveson	14-26	10-27	1.40-1.55	0.6-6.0	0.15-0.17	7.4-8.4	<2	Low	0.24			
	26-60	5-20	1.50-1.65	2.0-20	0.05-0.15	7.4-8.4	<2	Low	0.17			
71	0-12	4-12	1.35-1.60	6.0-20	0.10-0.12	7.4-8.4	<2	Low	0.17	5	2	2-[illegible]
Fossum	12-20	1-10	1.40-1.55	6.0-20	0.06-0.11	7.4-8.4	<2	Low	0.17			
	20-60	1-5	1.50-1.70	6.0-20	0.05-0.09	7.4-8.4	<2	Low	0.17			
93	0-9	27-39	1.20-1.40	0.2-0.6	0.17-0.23	7.4-8.4	<4	Moderate	0.28	5	4L	3-7
Bearden	9-33	18-34	1.30-1.50	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate	0.28			
	33-60	18-34	1.30-1.80	0.06-2.0	0.16-0.22	7.4-8.4	<8	Moderate	0.43			
107	0-10	18-35	1.20-1.40	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low	0.28	5	4L	4-6
Winger	10-32	18-35	1.30-1.50	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low	0.28			
	32-60	18-32	1.50-1.70	0.2-2.0	0.14-0.19	7.4-8.4	<2	Low	0.28			
108	0-7	18-35	1.35-1.50	0.6-2.0	0.18-0.24	7.4-8.4	<2	Moderate	0.28	5	4L	4-7
McIntosh	7-25	18-35	1.40-1.50	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	0.28			
	25-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.28			
157A, 157B	0-27	40-59	1.10-1.30	0.2-2.0	0.14-0.18	6.1-7.8	<2	High	0.28	5	4	4-8
Wahpeton	27-60	40-59	1.10-1.40	0.2-2.0	0.13-0.17	7.4-7.8	<2	High	0.28			
184A	0-9	27-35	1.20-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L	4-7
Hamerly	9-25	18-35	1.20-1.60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28			
	25-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37			
184B	0-9	18-35	1.20-1.60	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L	4-7
Hamerly	9-20	18-30	1.20-1.60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Low	0.28			
	20-60	18-30	1.30-1.60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low	0.37			
187	0-14	---	0.13-0.42	0.6-6.0	0.35-0.48	6.6-7.8	<2	----------	0.20	2	3	50-90
Haug	14-20	10-18	1.20-1.60	0.6-6.0	0.12-0.24	6.6-8.4	<2	Low	0.20			
	20-60	10-18	1.40-1.60	0.6-2.0	0.11-0.19	7.4-8.4	<2	Low	0.20			
236	0-15	18-28	1.20-1.35	0.6-2.0	0.22-0.24	7.4-8.4	<4	Low	0.28	5	4L	5-8
Vallers	15-25	18-35	1.40-1.55	0.2-0.6	0.15-0.19	7.4-8.4	<4	Moderate	0.28			
	25-60	18-35	1.50-1.70	0.2-0.6	0.17-0.19	7.4-8.4	<4	Low	0.28			
245B	0-16	5-15	1.50-1.70	6.0-20	0.08-0.10	6.6-7.8	<2	Low	0.15	5	2	1-3
Lohnes	16-60	0-10	1.50-1.70	6.0-20	0.03-0.07	6.6-8.4	<2	Low	0.15			
290B, 290B2	0-11	10-18	1.20-1.40	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low	0.32	5	5	3-6
Rothsay	11-16	10-18	1.20-1.40	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low	0.43			
	16-60	10-18	1.20-1.40	0.6-6.0	0.20-0.22	7.4-8.4	<2	Low	0.43			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm		K	T		Pct
293B-------------	0-13	10-20	1.25-1.35	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low-------	0.20	5	3	2-4
Swenoda	13-21	10-18	1.30-1.45	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low-------	0.20			
	21-60	20-35	1.35-1.65	0.2-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.37			
335--------------	0-10	18-35	0.25-0.50	0.2-2.0	0.18-0.24	7.4-8.4	<2	Moderate	0.28	5	4L	10-50
Urness	10-48	18-35	0.30-1.00	0.2-2.0	0.16-0.22	7.4-8.4	<2	Moderate	0.28			
	48-60	18-35	1.00-1.65	0.2-2.0	0.14-0.20	7.4-8.4	<2	Moderate	0.28			
343A-------------	0-10	15-27	1.25-1.40	2.0-6.0	0.18-0.22	7.4-8.4	<4	Low-------	0.28	4	4L	3-7
Wheatville	10-37	5-18	1.35-1.55	2.0-6.0	0.15-0.21	7.4-8.4	<4	Low-------	0.28			
	37-60	35-80	1.15-1.50	0.06-0.2	0.10-0.14	7.4-7.8	<4	High------	0.28			
343B2------------	0-10	5-18	1.30-1.50	2.0-6.0	0.16-0.20	7.4-8.4	<4	Low-------	0.28	4	3	3-6
Wheatville	10-37	5-18	1.35-1.55	2.0-6.0	0.15-0.21	7.4-8.4	<4	Low-------	0.28			
	37-60	35-80	1.15-1.50	0.06-0.2	0.10-0.14	7.4-7.8	<4	High------	0.28			
344--------------	0-10	22-27	1.00-1.40	0.6-2.0	0.22-0.24	6.6-7.8	<2	Low-------	0.28	5	6	6-15
Quam	10-32	22-35	1.25-1.45	0.2-0.6	0.16-0.22	6.6-7.8	<2	Moderate	0.28			
	32-60	20-35	1.40-1.65	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37			
359--------------	0-34	27-34	1.15-1.25	0.6-2.0	0.19-0.22	7.4-8.4	<4	Moderate	0.28	5	4L	4-8
Lamoure	34-60	25-34	1.20-1.35	0.6-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.28			
402B-------------	0-8	10-18	1.25-1.40	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low-------	0.20	2	3	1-3
Sioux	8-11	10-20	1.20-1.50	2.0-6.0	0.10-0.15	6.6-8.4	<2	Low-------	0.20			
	11-60	0-10	1.60-1.75	>6.0	0.03-0.06	7.4-8.4	<2	Low-------	0.10			
403--------------	0-12	35-80	1.20-1.40	0.2-0.6	0.16-0.19	6.6-7.8	<2	High------	0.32	5	4	4-8
Viking	12-27	35-80	1.30-1.40	<0.06	0.10-0.14	7.4-8.4	<2	High------	0.32			
	27-60	60-80	1.30-1.45	<0.06	0.09-0.13	7.4-8.4	<2	High------	0.32			
413--------------	0-8	8-18	1.30-1.50	2.0-6.0	0.14-0.18	6.1-7.3	<2	Low-------	0.28	3	3	2-[illegible]
Osakis	8-19	8-18	1.30-1.50	0.6-6.0	0.14-0.19	6.1-7.3	<2	Low-------	0.28			
	19-60	0-5	1.50-1.70	6.0-20	0.02-0.04	7.4-8.4	<2	Low-------	0.10			
418--------------	0-32	27-34	1.15-1.25	0.6-2.0	0.19-0.22	7.4-8.4	<4	Moderate	0.28	5	4L	4-8
Lamoure	32-60	25-34	1.20-1.35	0.6-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.28			
425--------------	0-9	5-18	1.30-1.50	2.0-6.0	0.18-0.23	6.6-7.3	<4	Low-------	0.28	5	3	3-6
Donaldson	9-19	5-20	1.30-1.55	2.0-6.0	0.17-0.21	6.6-7.8	<4	Low-------	0.28			
	19-30	5-18	1.45-1.60	2.0-6.0	0.16-0.19	6.6-8.4	<4	Low-------	0.28			
	30-60	35-70	1.15-1.50	0.06-0.2	0.09-0.13	7.4-8.4	<4	High------	0.28			
426--------------	0-10	4-9	1.40-1.55	6.0-20	0.10-0.14	6.1-7.8	<2	Low-------	0.20	5	2	1-4
Foldahl	10-22	4-15	1.45-1.60	6.0-20	0.07-0.12	6.6-7.8	<2	Low-------	0.20			
	22-60	12-35	1.50-1.65	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37			
429--------------	0-9	55-75	1.00-1.20	0.06-0.2	0.13-0.16	6.6-7.3	0-4	High------	0.28	5	4	3-6
Northcote	9-20	60-85	1.15-1.50	0.06-0.2	0.10-0.14	6.6-7.8	0-4	High------	0.28			
	20-60	60-85	1.15-1.50	0.06-0.2	0.10-0.14	7.4-8.4	0-4	High------	0.28			
435--------------	0-9	8-18	1.25-1.45	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.28	2	3	3-8
Syrene	9-18	10-30	1.30-1.50	2.0-6.0	0.15-0.19	7.9-8.4	<2	Low-------	0.28			
	18-60	2-10	1.50-1.70	6.0-20	0.02-0.04	7.4-8.4	<2	Low-------	0.10			
494--------------	0-24	18-27	1.25-1.40	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6	4-9
Darnen	24-35	18-30	1.40-1.60	0.6-2.0	0.15-0.19	6.1-7.8	<2	Moderate	0.28			
	35-60	18-30	1.55-1.65	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37			
497--------------	0-18	10-27	1.20-1.40	0.6-2.0	0.22-0.24	6.6-7.8	<2	Low-------	0.28	5	5	4-6
Hantho	18-32	10-18	1.30-1.50	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low-------	0.28			
	32-60	10-27	1.30-1.60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.43			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
508-------------- Wyndmere	0-11	5-15	1.30-1.60	2.0-6.0	0.13-0.18	7.9-8.4	<2	Low-------	0.20	5	3	5-13
	11-27	0-10	1.30-1.70	2.0-6.0	0.12-0.17	7.9-8.4	<2	Low-------	0.20			
	27-60	0-10	1.30-1.70	2.0-6.0	0.06-0.16	7.9-8.4	<2	Low-------	0.20			
510-------------- Elmville	0-15	5-18	1.30-1.50	2.0-6.0	0.16-0.22	7.4-8.4	<4	Low-------	0.20	5	3	4-8
	15-34	5-18	1.30-1.55	2.0-6.0	0.12-0.17	7.4-8.4	<4	Low-------	0.20			
	34-60	35-70	1.15-1.45	0.06-0.2	0.10-0.14	7.4-7.8	<4	Moderate	0.28			
540-------------- Seelyeville	0-4	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-8.4	<2	----------	----	2	2	>25
	4-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-8.4	<2	----------	----			
547-------------- Deerwood	0-12	---	0.10-0.30	2.0-6.0	0.35-0.45	5.6-7.8	<2	----------	----	5	3	50-90
	12-28	2-18	1.20-1.70	2.0-20	0.09-0.17	6.1-8.4	<2	Low-------	0.17			
	28-60	0-10	1.50-1.70	6.0-20	0.02-0.07	7.4-8.4	<2	Low-------	0.17			
582-------------- Roliss	0-10	18-35	1.10-1.50	0.2-2.0	0.17-0.24	6.6-7.8	<2	Moderate	0.28	5	6	3-7
	10-17	18-35	1.30-1.70	0.2-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.28			
	17-60	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.28			
640-------------- Galchutt	0-10	18-27	1.10-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Moderate	0.32	4	6	4-8
	10-13	15-25	1.30-1.50	0.6-2.0	0.17-0.22	6.6-7.3	<2	Moderate	0.32			
	13-60	40-60	1.30-1.50	0.06-0.2	0.13-0.16	6.6-7.8	<2	High------	0.32			
642-------------- Clearwater	0-9	10-27	1.30-1.60	0.6-6.0	0.10-0.16	6.6-7.8	<2	Low-------	0.24	5	3	2-5
	9-17	35-60	1.20-1.50	0.06-0.2	0.15-0.18	7.4-8.4	<2	High------	0.32			
	17-60	35-60	1.20-1.60	0.06-0.2	0.15-0.18	7.4-8.4	<2	High------	0.32			
645-------------- Espelie	0-11	8-18	1.30-1.45	2.0-6.0	0.13-0.18	6.6-7.3	<2	Low-------	0.20	4	3	2-4
	11-27	3-10	1.35-1.60	2.0-6.0	0.06-0.11	6.6-7.8	<2	Low-------	0.17			
	27-60	35-60	1.35-1.60	0.06-0.2	0.09-0.19	7.4-8.4	<2	High------	0.32			
647-------------- Hilaire	0-10	6-15	1.25-1.45	6.0-20	0.10-0.14	6.6-7.3	<2	Low-------	0.15	4	2	1-3
	10-26	1-10	1.20-1.40	6.0-20	0.07-0.12	6.6-7.8	<2	Low-------	0.10			
	26-60	35-60	1.35-1.55	0.06-0.2	0.09-0.19	7.4-8.4	<2	High------	0.32			
698-------------- Doran	0-9	18-35	1.25-1.45	0.2-0.6	0.18-0.23	6.6-7.3	<2	Moderate	0.28	5	7	4-8
	9-22	35-50	1.30-1.60	0.06-0.6	0.15-0.19	6.6-7.8	<2	High------	0.28			
	22-60	20-40	1.45-1.65	0.2-2.0	0.14-0.16	7.4-8.4	<2	High------	0.37			
814*:												
Hamerly---------	0-10	27-35	1.20-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L	4-7
	10-17	18-35	1.20-1.60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28			
	17-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37			
Lindaas---------	0-9	25-35	1.10-1.30	0.6-2.0	0.18-0.23	6.6-7.3	<2	Moderate	0.32	3	6	5-10
	9-27	40-50	1.20-1.40	0.06-0.2	0.14-0.17	6.6-7.8	<2	High------	0.32			
	27-60	20-35	1.20-1.50	0.2-2.0	0.17-0.22	7.9-8.4	<2	Moderate	0.43			
821*:												
Doran-----------	0-9	18-35	1.25-1.45	0.2-0.6	0.18-0.23	6.6-7.3	<2	Moderate	0.28	5	7	4-8
	9-19	35-50	1.30-1.60	0.06-0.6	0.15-0.19	6.6-7.8	<2	High------	0.28			
	19-60	20-40	1.45-1.65	0.2-2.0	0.14-0.16	7.4-8.4	<2	High------	0.37			
Lindaas---------	0-12	25-35	1.10-1.30	0.6-2.0	0.18-0.23	6.6-7.3	<2	Moderate	0.32	3	6	5-10
	12-30	40-50	1.20-1.40	0.06-0.2	0.14-0.17	6.6-7.8	<2	High------	0.32			
	30-60	20-35	1.20-1.50	0.2-2.0	0.17-0.22	7.9-8.4	<2	Moderate	0.43			
903B2*:												
Barnes----------	0-10	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	<2	Low-------	0.28	5	6	2-5
	10-20	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	<2	Low-------	0.28			
	20-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	<4	Low-------	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
903B2*:												
Langhei---------	0-8	18-30	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-------	0.32	5	4L	.5-3
	8-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	<2	Low-------	0.37			
908*:												
Bearden---------	0-13	27-39	1.20-1.40	0.2-0.6	0.17-0.23	7.4-8.4	<4	Moderate	0.28	5	4L	3-7
	13-22	18-34	1.30-1.50	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate	0.28			
	22-60	18-34	1.30-1.80	0.06-2.0	0.16-0.22	7.4-8.4	<8	Moderate	0.43			
Fargo-----------	0-12	40-60	1.10-1.30	0.06-0.2	0.15-0.18	6.6-7.8	<2	High------	0.32	5	4	4-10
	12-21	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.6-7.8	<2	High------	0.32			
	21-60	40-60	1.20-1.50	0.06-0.2	0.14-0.17	7.9-8.4	<2	High------	0.32			
942C2*, 942D2*:												
Langhei---------	0-6	18-30	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-------	0.32	5	4L	.5-3
	6-60	18-32	1.50-1.65	0.6-2.0	0.15-0.19	7.4-8.4	<2	Low-------	0.37			
Barnes----------	0-8	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	<2	Low-------	0.28	5	6	2-5
	8-19	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	<2	Low-------	0.28			
	19-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	<4	Low-------	0.37			
957B2*:												
Rothsay---------	0-10	10-18	1.20-1.40	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low-------	0.32	5	5	3-6
	10-20	10-18	1.20-1.40	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low-------	0.43			
	20-60	10-18	1.20-1.40	0.6-6.0	0.20-0.22	7.4-8.4	<2	Low-------	0.43			
Zell------------	0-8	10-18	1.15-1.30	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-------	0.32	5	4L	2-5
	8-28	10-18	1.25-1.40	0.6-2.0	0.15-0.20	7.4-8.4	<2	Low-------	0.43			
	28-60	5-18	1.25-1.40	0.6-2.0	0.15-0.20	7.4-8.4	<2	Low-------	0.43			
969B*, 969C2*, 969D2*:												
Zell-----------	0-7	10-18	1.15-1.30	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-------	0.32	5	4L	2-5
	7-36	10-18	1.25-1.40	0.6-2.0	0.15-0.20	7.4-8.4	<2	Low-------	0.43			
	36-60	5-18	1.25-1.40	0.6-2.0	0.15-0.20	7.4-8.4	<2	Low-------	0.43			
Rothsay--------	0-11	10-18	1.20-1.40	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low-------	0.32	5	5	3-6
	11-16	10-18	1.20-1.40	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low-------	0.43			
	16-60	10-18	1.20-1.40	0.6-6.0	0.20-0.22	7.4-8.4	<2	Low-------	0.43			
987-------------- Rockwell	0-12	10-20	1.25-1.45	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low-------	0.24	5	3	4-8
	12-19	5-30	1.35-1.50	2.0-6.0	0.15-0.17	7.9-8.4	<2	Low-------	0.24			
	19-26	3-10	1.40-1.60	6.0-20	0.05-0.07	7.4-7.8	<2	Low-------	0.24			
	26-60	15-30	1.40-1.60	0.2-2.0	0.18-0.22	7.4-7.8	<2	Low-------	0.24			
1029*. Pits												
1055*: Haplaquolls.												
Histosols.												
1819------------- Glyndon	0-18	27-35	1.25-1.40	0.6-2.0	0.18-0.22	7.4-9.0	<4	Moderate	0.28	4	4L	4-8
	18-24	10-18	1.30-1.50	0.6-6.0	0.17-0.20	7.4-9.0	<4	Low-------	0.28			
	24-60	5-18	1.35-1.65	2.0-6.0	0.15-0.19	7.4-9.0	<4	Low-------	0.28			
1871------------- Fargo	0-10	40-65	1.00-1.20	0.06-0.2	0.15-0.18	6.6-7.8	<2	High------	0.32	5	4	4-8
	10-18	40-65	1.15-1.50	0.06-0.2	0.14-0.17	6.6-7.8	<2	High------	0.32			
	18-60	40-65	1.15-1.50	0.06-0.2	0.14-0.17	7.9-8.4	<2	High------	0.32			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
1872------------- Fargo	0-13 13-30 30-60	40-60 40-60 20-35	1.10-1.30 1.20-1.45 1.30-1.50	0.06-0.2 0.06-0.2 0.2-2.0	0.15-0.18 0.14-0.17 0.15-0.20	6.6-7.3 6.6-7.8 7.9-8.4	<2 <2 <2	High------ High------ Moderate	0.32 0.32 0.32	5	4	4-10
1874------------- Lohnes	0-12 12-60	5-15 0-10	1.50-1.70 1.50-1.70	2.0-20 6.0-20	0.10-0.13 0.03-0.07	6.6-7.8 6.6-8.4	<2 <2	Low------- Low-------	0.24 0.15	5	3	1-3
1913C*: Wahpeton--------	0-17 17-60	40-59 35-59	1.10-1.30 1.10-1.40	0.2-2.0 0.2-2.0	0.14-0.18 0.13-0.17	6.1-7.8 7.4-7.8	<2 <2	High------ High------	0.28 0.28	5	4	4-8
Cashel----------	0-14 14-60	40-60 35-60	1.20-1.40 1.30-1.70	0.06-0.6 0.06-0.6	0.15-0.18 0.13-0.17	7.4-8.4 7.4-8.4	<2 <2	High------ High------	0.32 0.32	5	4	4-8
1916------------- Lindaas	0-9 9-27 27-60	25-35 40-50 20-35	1.10-1.30 1.20-1.40 1.20-1.50	0.6-2.0 0.06-0.2 0.2-2.0	0.18-0.23 0.14-0.17 0.17-0.22	6.6-7.3 6.6-7.8 7.9-8.4	<2 <2 <2	Moderate High------ Moderate	0.32 0.32 0.43	3	6	5-10
1921------------- Foldahl	0-10 10-22 22-60	4-15 4-15 12-35	1.30-1.50 1.45-1.60 1.50-1.65	2.0-6.0 6.0-20 0.2-2.0	0.14-0.18 0.07-0.12 0.14-0.19	6.1-7.8 6.6-7.8 7.4-8.4	<2 <2 <2	Low------- Low------- Moderate	0.20 0.20 0.37	5	3	2-5
1944------------- Perella	0-9 9-19 19-60	40-59 18-34 18-34	1.20-1.40 1.30-1.50 1.30-1.60	0.06-0.2 0.06-0.6 0.2-0.6	0.15-0.18 0.15-0.22 0.16-0.22	6.6-7.8 6.6-7.8 7.4-8.4	<2 <2 <2	High------ Moderate Moderate	0.28 0.28 0.28	5	4	4-8
1948*: Fargo-----------	0-10 10-22 22-60	40-60 40-60 40-60	1.10-1.30 1.20-1.50 1.20-1.50	0.06-0.2 0.06-0.2 0.06-0.2	0.15-0.18 0.14-0.17 0.14-0.17	6.6-7.8 6.6-7.8 7.9-8.4	<2 <2 <2	High------ High------ High------	0.32 0.32 0.32	5	4	4-10
Enloe-----------	0-14 14-33 33-60	27-40 45-60 27-50	1.20-1.30 1.20-1.30 1.20-1.40	0.06-0.2 0.06-0.2 0.06-0.2	0.18-0.23 0.14-0.17 0.13-0.16	5.6-7.3 6.1-7.8 7.4-7.8	<2 <2 <2	High------ High------ High------	0.32 0.32 0.32	3	7	5-10
1971------------- Divide	0-9 9-23 23-60	15-30 18-30 0-10	1.10-1.40 1.20-1.50 1.30-1.70	0.6-2.0 0.6-2.0 >6.0	0.18-0.22 0.16-0.19 0.03-0.07	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low------- Low------- Low-------	0.28 0.28 0.10	4	4L	2-8

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
26 Aazdahl	B	None	---	---	3.0-6.0	Apparent	Mar-May	High	Moderate	Low.
33B, 33B2 Barnes	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
34 Parnell	C/D	Rare	---	---	+2-2.0	Apparent	Jan-Dec	High	High	Low.
46 Borup	B/D	Rare	---	---	1.0-2.5	Apparent	Apr-Jul	High	High	Low.
47 Colvin	C/D	Rare	---	---	1.0-2.0	Apparent	Apr-Jul	High	High	Low.
50 Cashel	C	Occasional	Brief	Mar-May	1.0-3.0	Apparent	Apr-Jul	Moderate	High	Low.
52 Augsburg	B/D	Rare	---	---	1.0-3.0	Apparent	Apr-Jul	High	High	Low.
56, 57A, 57B Fargo	D	Rare	---	---	0-3.0	Apparent	Sep-Jun	High	High	Low.
58 Kittson	C	None	---	---	2.5-6.0	Apparent	Nov-Jun	High	High	Low.
59 Grimstad	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	Moderate	Moderate	Low.
60 Glyndon	B	None	---	---	2.5-6.0	Apparent	Apr-Jul	High	High	Low.
61 Arveson	B/D	Rare	---	---	1.0-2.0	Apparent	Apr-Jul	High	High	Low.
63 Rockwell	B/D	Rare	---	---	1.0-3.0	Apparent	Apr-Jul	High	High	Low.
64 Ulen	B	None	---	---	2.5-6.0	Apparent	Apr-Jul	Moderate	Low	Low.
65 Foxhome	B	None	---	---	2.5-6.0	Apparent	Nov-Jun	High	Moderate	Low.
66 Flaming	A	None	---	---	2.5-4.0	Apparent	Nov-Jun	Moderate	Low	Low.
67A, 67B2 Bearden	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	High	High	Low.
68 Arveson	B/D	Rare	---	---	+1-1.0	Apparent	Jan-Dec	High	High	Low.
71 Fossum	A/D	Rare	---	---	1.0-2.5	Apparent	Nov-Oct	Moderate	High	Low.

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TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
93---------------- Bearden	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
107--------------- Winger	B/D	Rare---------	---	---	1.0-3.0	Apparent	Nov-Jun	High-----	High-----	Low.
108--------------- McIntosh	B	None---------	---	---	3.0-6.0	Apparent	Apr-Nov	High-----	High-----	Low.
157A, 157B-------- Wahpeton	C	Occasional	Brief-----	Mar-Jun	>6.0	---	---	High-----	High-----	Low.
184A-------------- Hamerly	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
184B-------------- Hamerly	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
187--------------- Haug	B/D	Rare---------	---	---	+1-3.0	Apparent	Jan-Dec	High-----	High-----	Low.
236--------------- Vallers	C	Rare---------	---	---	1.0-2.5	Apparent	Nov-Jun	High-----	High-----	Low.
245B-------------- Lohnes	A	None---------	---	---	>6.0	---	---	Low------	Moderate	Low.
290B, 290B2------- Rothsay	B	None---------	---	---	>6.0	---	---	High-----	Low------	Low.
293B-------------- Swenoda	B	None---------	---	---	2.5-4.0	Perched	Mar-Jun	Moderate	High-----	Moderate.
335--------------- Urness	B/D	Rare---------	---	---	+2-1.0	Apparent	Jan-Dec	High-----	High-----	Low.
343A, 343B2------- Wheatville	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	High-----	High-----	Low.
344--------------- Quam	B/D	None---------	---	---	+2-1.0	Apparent	Jan-Dec	High-----	High-----	Low.
359--------------- Lamoure	C	Frequent----	Brief-----	Mar-Oct	0-2.0	Apparent	Oct-Jun	High-----	High-----	Moderate.
402B-------------- Sioux	A	None---------	---	---	>6.0	---	---	Low------	Low------	Low.
403--------------- Viking	D	Rare---------	---	---	1.0-3.0	Apparent	Apr-Jul	Moderate	High-----	Low.
413--------------- Osakis	B	None---------	---	---	3.0-6.0	Apparent	Nov-Jun	Moderate	Low------	Low.
418--------------- Lamoure	C	Occasional	Brief-----	Mar-Oct	0-2.0	Apparent	Oct-Jun	High-----	High-----	Moderate.
425--------------- Donaldson	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	High-----	High-----	Low.
426--------------- Foldahl	B	None---------	---	---	2.5-4.0	Apparent	Nov-Jun	High-----	Moderate	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
429---------------- Northcote	C/D	Rare---------	---	---	1.0-3.0	Apparent	Apr-Jul	High-----	High-----	Low.
435---------------- Syrene	B/D	Rare---------	---	---	1.0-3.0	Apparent	Apr-Jul	Moderate	High-----	Low.
494---------------- Darnen	B	None---------	---	---	2.5-6.0	Apparent	Nov-Jun	Moderate	High-----	Low.
497---------------- Hantho	B	None---------	---	---	3.0-5.0	Apparent	Mar-Jun	High-----	Moderate	Low.
508---------------- Wyndmere	B	None---------	---	---	2.0-5.0	Apparent	Sep-Jun	High-----	High-----	Low.
510---------------- Elmville	B	None---------	---	---	2.5-5.0	Apparent	Apr-Jul	High-----	High-----	Low.
540---------------- Seelyeville	A/D	Rare---------	---	---	+2-2.0	Apparent	Jan-Dec	High-----	High-----	Moderate.
547---------------- Deerwood	B/D	Rare---------	---	---	+1-1.0	Apparent	Jan-Dec	Moderate	High-----	Low.
582---------------- Roliss	B/D	Rare---------	---	---	1.0-3.0	Apparent	Apr-Jul	High-----	High-----	Low.
640---------------- Galchutt	C	None---------	---	---	1.0-3.0	Perched	Apr-Jun	High-----	High-----	Low.
642---------------- Clearwater	D	Rare---------	---	---	1.0-3.0	Apparent	Apr-Jul	High-----	High-----	Low.
645---------------- Espelie	B/D	Rare---------	---	---	1.0-3.0	Apparent	Apr-Jun	High-----	High-----	Low.
647---------------- Hilaire	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jun	High-----	Moderate	Low.
698---------------- Doran	C	None---------	---	---	3.0-5.0	Apparent	Apr-Jun	High-----	High-----	Low.
814*:										
Hamerly-----------	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
Lindaas-----------	C/D	Rare---------	---	---	+1-2.0	Apparent	Apr-Jun	High-----	High-----	Low.
821*:										
Doran-------------	C	None---------	---	---	3.0-5.0	Apparent	Apr-Jun	High-----	High-----	Low.
Lindaas-----------	C/D	Rare---------	---	---	+1-2.0	Apparent	Apr-Jun	High-----	High-----	Low.
903B2*:										
Barnes------------	B	None---------	---	---	>6.0	---	---	Moderate	Moderate	Low.
Langhei-----------	B	None---------	---	---	>6.0	---	---	Moderate	Low------	Low.
908*:										
Bearden-----------	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
Fargo-------------	D	Rare---------	---	---	0-3.0	Apparent	Sep-Jun	High-----	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
942C2*, 942D2*:										
Langhei	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Barnes	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
957B2*:										
Rothsay	B	None	---	---	>6.0	---	---	High	Low	Low.
Zell	B	None	---	---	>6.0	---	---	High	High	Moderate.
969B*, 969C2*, 969D2*:										
Zell	B	None	---	---	>6.0	---	---	High	High	Moderate.
Rothsay	B	None	---	---	>6.0	---	---	High	Low	Low.
987 Rockwell	B/D	Rare	---	---	+1-1.0	Apparent	Jan-Dec	High	High	Low.
1029*. Pits										
1055*:										
Haplaquolls.										
Histosols.										
1819 Glyndon	B	None	---	---	2.5-6.0	Apparent	Apr-Jul	High	High	Low.
1871 Fargo	D	Rare	---	---	+.5-1.0	Apparent	Jan-Dec	High	High	Low.
1872 Fargo	D	Rare	---	---	1.0-3.0	Apparent	Sep-Jun	High	High	Low.
1874 Lohnes	A	None	---	---	3.0-5.0	Apparent	Apr-Oct	Low	Moderate	Low.
1913C*:										
Wahpeton	C	Occasional	Brief	Mar-Jun	>6.0	---	---	High	High	Low.
Cashel	C	Frequent	Brief	Mar-May	1.0-3.0	Apparent	Apr-Jul	Moderate	High	Low.
1916 Lindaas	C/D	Rare	---	---	+1-2.0	Apparent	Apr-Jun	High	High	Low.
1921 Foldahl	B	None	---	---	2.5-4.0	Apparent	Nov-Jun	High	Moderate	Low.
1944 Perella	B	None	---	---	2.0-4.0	Apparent	Apr-Jun	High	High	Low.
1948*:										
Fargo	D	Rare	---	---	0-3.0	Apparent	Sep-Jun	High	High	Low.
Enloe	D	Rare	---	---	+1-1.0	Apparent	Apr-Jun	High	High	Low.
1971 Divide	B	None	---	---	2.5-5.0	Apparent	Apr-Jun	Moderate	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Aazdahl	Fine-loamy, mixed Aquic Haploborolls
Arveson	Coarse-loamy, frigid Typic Calciaquolls
Augsburg	Coarse-silty over clayey, frigid Typic Calciaquolls
Barnes	Fine-loamy, mixed Udic Haploborolls
Bearden	Fine-silty, frigid Aeric Calciaquolls
Borup	Coarse-silty, frigid Typic Calciaquolls
Cashel	Fine, montmorillonitic (calcareous), frigid Mollic Udifluvents
Clearwater	Fine, montmorillonitic (calcareous), frigid Typic Haplaquolls
Colvin	Fine-silty, frigid Typic Calciaquolls
Darnen	Fine-loamy, mixed Pachic Udic Haploborolls
Deerwood	Sandy, mixed, frigid Histic Humaquepts
Divide	Fine-loamy over sandy or sandy-skeletal, frigid Aeric Calciaquolls
Donaldson	Coarse-loamy over clayey, mixed Aquic Haploborolls
Doran	Fine, mixed Aquic Argiborolls
Elmville	Coarse-loamy over clayey, frigid Aeric Calciaquolls
Enloe	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Espelie	Sandy over clayey, mixed, frigid Typic Haplaquolls
Fargo	Fine, montmorillonitic, frigid Vertic Haplaquolls
Flaming	Sandy, mixed Aquic Haploborolls
Foldahl	Sandy over loamy, mixed Aquic Haploborolls
Fossum	Sandy, mixed (calcareous), frigid Typic Haplaquolls
Foxhome	Sandy-skeletal over loamy, mixed Aquic Haploborolls
Galchutt	Fine, montmorillonitic, frigid Typic Argialbolls
Glyndon	Coarse-silty, frigid Aeric Calciaquolls
Grimstad	Sandy over loamy, frigid Aeric Calciaquolls
Hamerly	Fine-loamy, frigid Aeric Calciaquolls
*Hantho	Coarse-silty, mixed Pachic Udic Haploborolls
Haplaquolls	Loamy, mixed, frigid Haplaquolls
Haug	Coarse-loamy, mixed (calcareous), frigid Histic Humaquepts
Hilaire	Sandy over clayey, mixed Aquic Haploborolls
Histosols	Euic, frigid Histosols
Kittson	Fine-loamy, mixed Aquic Haploborolls
Lamoure	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Langhei	Fine-loamy, mixed (calcareous), frigid Typic Udorthents
Lindaas	Fine, montmorillonitic, frigid Typic Argiaquolls
Lohnes	Sandy, mixed Udorthentic Haploborolls
McIntosh	Fine-silty, frigid Aeric Calciaquolls
Northcote	Very fine, montmorillonitic, frigid Vertic Haplaquolls
Osakis	Sandy, mixed Aquic Haploborolls
Parnell	Fine, montmorillonitic, frigid Typic Argiaquolls
Perella	Fine-silty, mixed, frigid Typic Haplaquolls
Quam	Fine-silty, mixed, frigid Cumulic Haplaquolls
Rockwell	Coarse-loamy, frigid Typic Calciaquolls
Roliss	Fine-loamy, mixed (calcareous), frigid Typic Haplaquolls
Rothsay	Coarse-silty, mixed Udic Haploborolls
Seelyeville	Euic Typic Borosaprists
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Swenoda	Coarse-loamy, mixed Pachic Udic Haploborolls
Syrene	Sandy, frigid Typic Calciaquolls
Ulen	Sandy, frigid Aeric Calciaquolls
Urness	Fine-silty, mixed (calcareous), frigid Mollic Fluvaquents
Vallers	Fine-loamy, frigid Typic Calciaquolls
Viking	Very fine, montmorillonitic (calcareous), frigid Typic Haplaquolls
Wahpeton	Fine, montmorillonitic Udertic Haploborolls
Wheatville	Coarse-silty over clayey, frigid Aeric Calciaquolls
Winger	Fine-silty, frigid Typic Calciaquolls
Wyndmere	Coarse-loamy, frigid Aeric Calciaquolls
Zell	Coarse-silty, mixed Udorthentic Haploborolls

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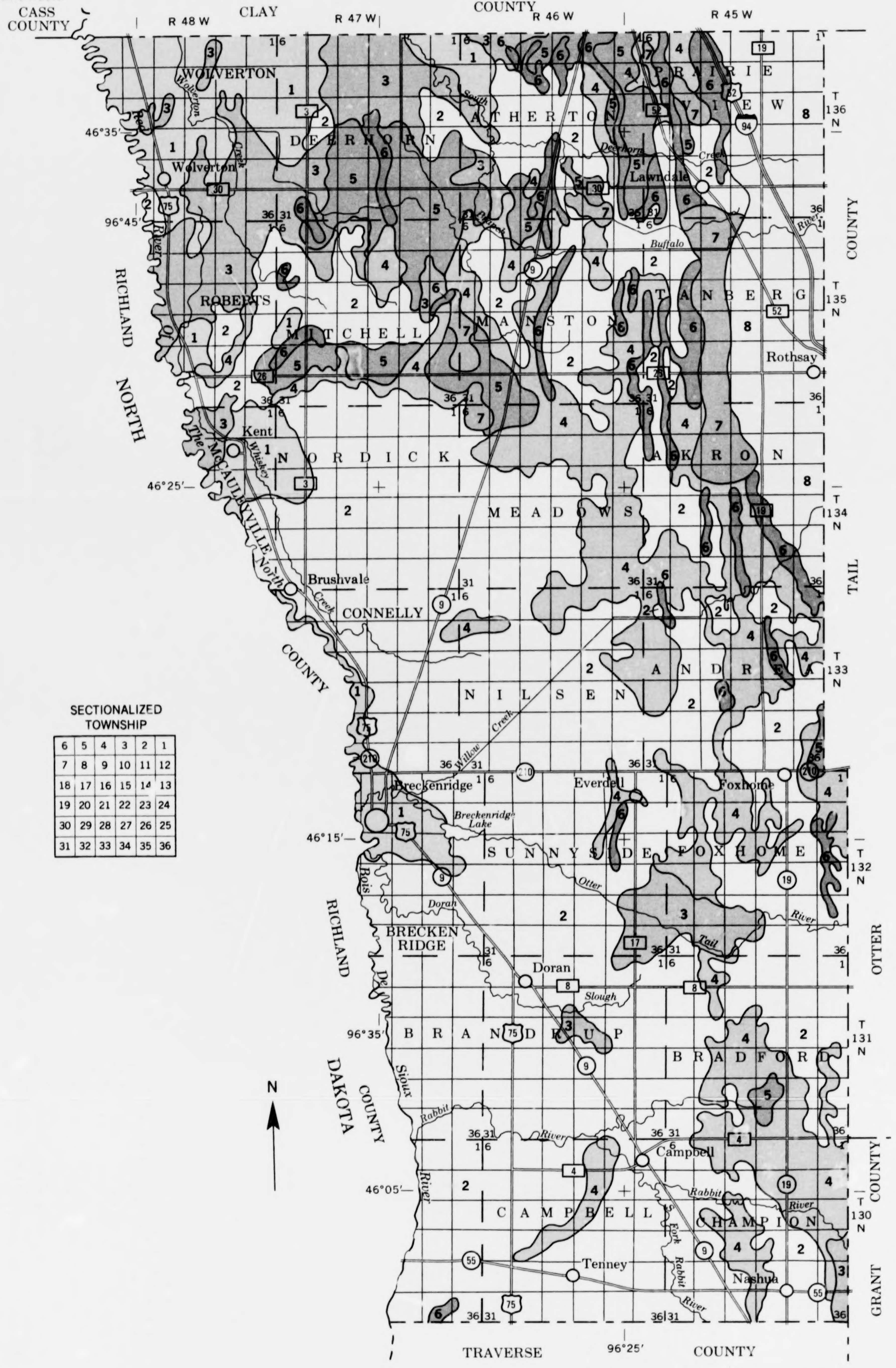
MAPS

TRANSPOSED TO

END OF VOLUME

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.


CASS COUNTY
CLAY COUNTY
OTTER TAIL COUNTY
GRANT COUNTY
TRAVERSE COUNTY
RICHLAND NORTH DAKOTA COUNTY
R 48 W
R 47 W
R 46 W
R 45 W
T 136 N
T 135 N
T 134 N
T 133 N
T 132 N
T 131 N
T 130 N
46°35'
96°45'
46°25'
46°15'
96°35'
46°05'
96°25'
WOLVERTON
DEERHORN
ATHERTON
PRAIRIE VIEW
ROBERTS
MITCHELL
MANSTON
TANBERG
NORDICK
AKRON
MEADOWS
CONNELLY
NILSEN
ANDREA
BRECKEN RIDGE
SUNNYSIDE
FOXHOME
BRANDRUP
BRADFORD
CAMPBELL
CHAMPION
Wolverton
Lawndale
Rothsay
Kent
McCauleyville
Brushvale
Breckenridge
Everdell
Foxhome
Doran
Campbell
Tenney
Nashua
Red River
Buffalo River
Whiskey Creek
Otter Tail River
Bois de Sioux River
Rabbit River
Doran Slough
Breckenridge Lake
N

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

LEGEND

- 1 — FARGO-NORTHCOTE association: Nearly level and gently sloping, poorly drained soils formed in clayey lacustrine sediments; on lake plains
- 2 — HAMERLY-DORAN association: Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy glacial till and in lacustrine sediments; on uplands, lake plains, and till plains
- 3 — WHEATVILLE-BEARDEN-GLYNDON association: Nearly level and gently sloping, somewhat poorly drained and moderately well drained soils formed in silty or loamy lacustrine sediments; on lake plains
- 4 — ELMVILLE-DONALDSON association: Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy or sandy lacustrine sediments or in glacial till; on lake plains
- 5 — WYNDMERE-ULEN-FLAMING association: Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy or sandy sediments; on lake plains
- 6 — LOHNES-SIOUX association: Nearly level and gently sloping, moderately well drained, well drained, and excessively drained soils formed in sandy or loamy deposits; on lake plains and outwash plains
- 7 — URNESS-HAUG association: Level, very poorly drained soils formed in silty lacustrine sediments or organic deposits; on lake plains and ground moraines
- 8 — BARNES-ROTHSAY association: Nearly level to hilly, well drained soils formed in loamy or silty glacial till or lacustrine deposits; on till plains, lake plains, and moraines

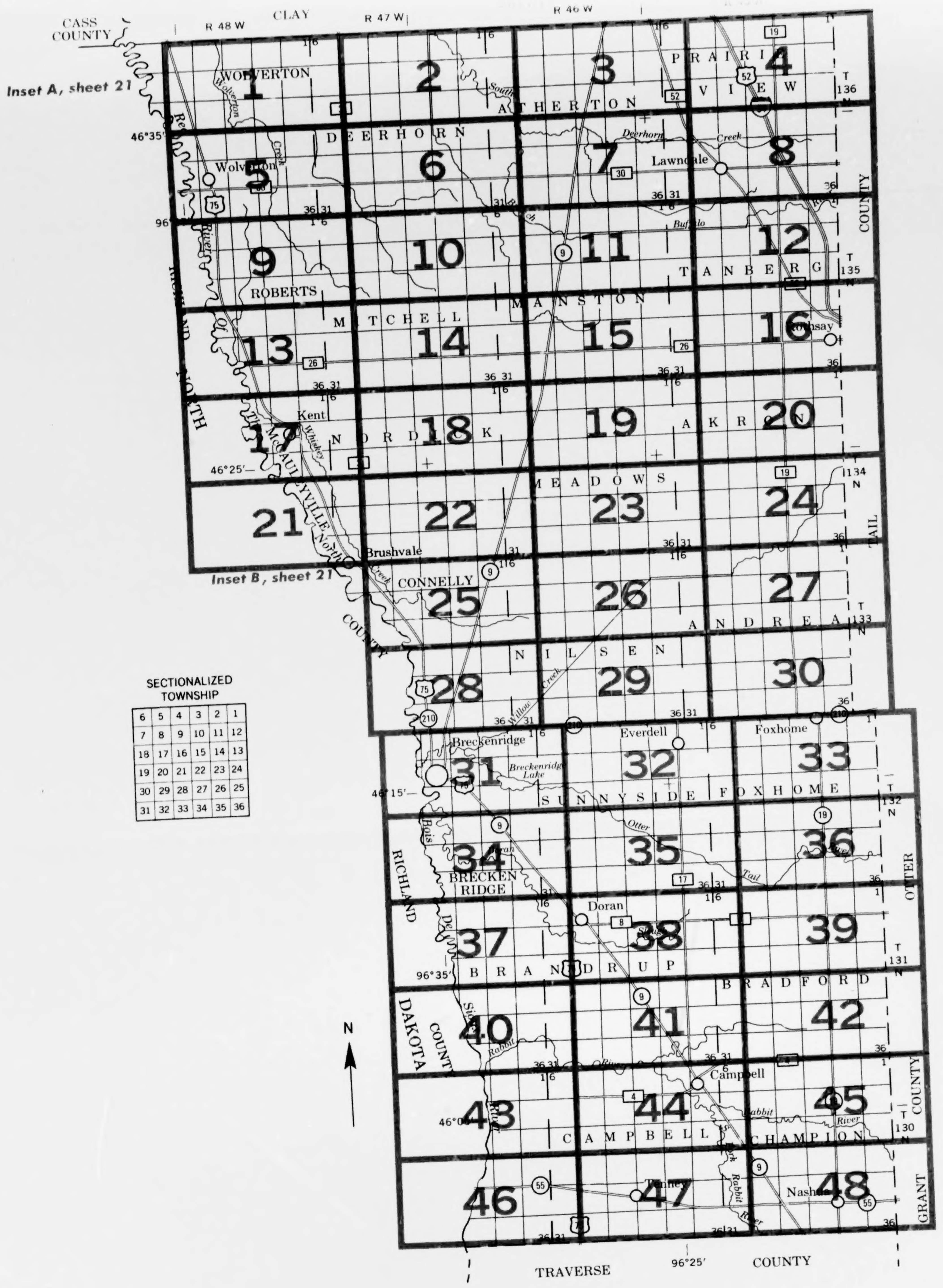
COMPILED 1987

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

WILKIN COUNTY, MINNESOTA

Scale 1:253,440
1 0 1 2 3 4 Miles
1 0 4 8 Km


CASS COUNTY
CLAY
R 48 W
R 47 W
R 46 W
Inset A, sheet 21
Inset B, sheet 21
46°35'
46°25'
46°15'
46°05'
96°35'
96°25'
T 136 N
T 135 N
T 134 N
T 133 N
T 132 N
T 131 N
T 130 N
WOLVERTON
DEERHORN
ATHERTON
PRAIRIE VIEW
ROBERTS
MITCHELL
MANSTON
TANBERG
NORDICK
AKRON
McCAULEYVILLE
MEADOWS
CONNELLY
ANDREA
NILSEN
SUNNYSIDE
FOXHOME
BRECKENRIDGE
BRANDRUP
BRADFORD
CAMPBELL
CHAMPION
Wolverton
Lawndale
Rothsay
Kent
Brushvale
Everdell
Foxhome
Breckenridge
Breckenridge Lake
Doran
Campbell
Tenney
Nashua
RICHLAND
NORTH
DAKOTA
COUNTY
OTTER
TAIL
COUNTY
GRANT
TRAVERSE
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SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
WILKIN COUNTY, MINNESOTA

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WILKIN COUNTY, MINNESOTA

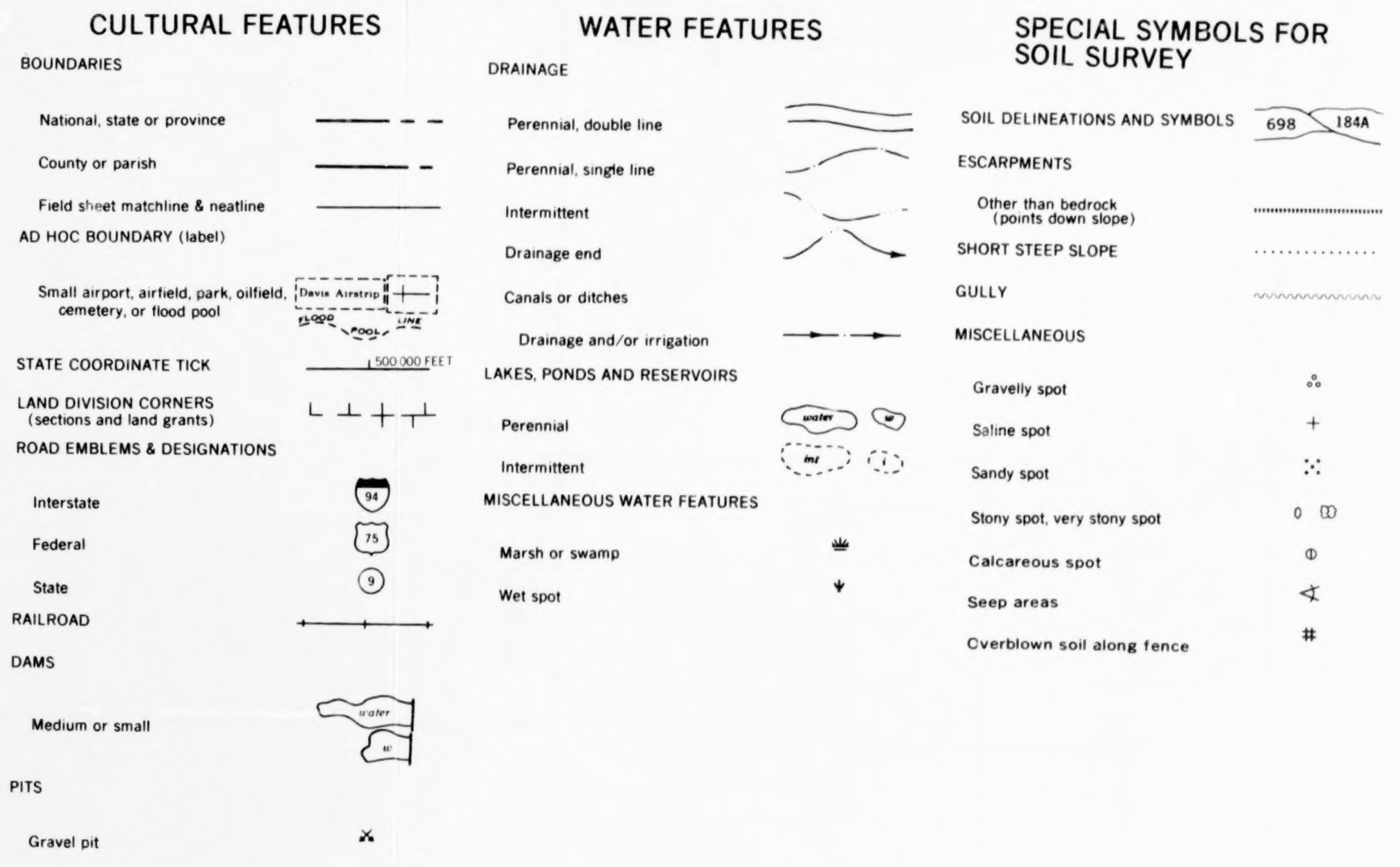
MINNESOTA AGRICULTURAL EXPERIMENT STATION

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is eroded.

SYMBOL	NAME
26	Aazdahl clay loam
33B	Barnes loam, 1 to 6 percent slopes
33B2	Barnes loam, 2 to 6 percent slopes, eroded
34	Parnell silt loam
46	Borup loam
47	Colvin silty clay loam
50	Cashel silty clay
52	Augsburg very fine sandy loam
56	Fargo silty clay loam
57A	Fargo silty clay, 0 to 2 percent slopes
57B	Fargo silty clay, 2 to 6 percent slopes
58	Kittson loam
59	Grimstad sandy loam
60	Glyndon very fine sandy loam
61	Arveson loam
63	Rockwell loam
64	Ulen fine sandy loam
65	Foxhome sandy loam
66	Flaming loamy fine sand
67A	Bearden silt loam, 0 to 2 percent slopes
67B2	Bearden silt loam, 2 to 6 percent slopes, eroded
68	Arveson loam, depressional
71	Fossum loamy fine sand
93	Bearden silty clay loam
107	Winger silt loam
108	McIntosh silt loam
157A	Wahpeton clay, 0 to 2 percent slopes
157B	Wahpeton clay, 2 to 6 percent slopes
184A	Hamerly clay loam, 0 to 2 percent slopes
184B	Hamerly loam, 1 to 4 percent slopes
187	Haug muck
236	Vallers loam
245B	Lohnes loamy sand, 1 to 6 percent slopes
290B	Rothsay silt loam, 2 to 4 percent slopes
290B2	Rothsay silt loam, 2 to 6 percent slopes, eroded
293B	Swenoda fine sandy loam, 1 to 4 percent slopes
335	Urness mucky silt loam
343A	Wheatville silt loam, 0 to 2 percent slopes
343B2	Wheatville very fine sandy loam, 2 to 6 percent slopes, eroded
344	Quam silt loam
359	Lamoure silty clay loam, frequently flooded
402B	Sioux sandy loam, 1 to 6 percent slopes
403	Viking silty clay
413	Osakis sandy loam
418	Lamoure silty clay loam, occasionally flooded
425	Donaldson very fine sandy loam
426	Foldahl loamy fine sand
429	Northcote clay
435	Syrene sandy loam
494	Darnen silt loam
497	Hantho silt loam
508	Wyndmere fine sandy loam
510	Elmville very fine sandy loam
540	Seelyeville muck
547	Deerwood muck
582	Roliss clay loam
640	Galchutt silt loam
642	Clearwater sandy clay loam
645	Espelie fine sandy loam
647	Hilaire loamy fine sand
698	Doran clay loam
814	Hamerly-Lindaas silty clay loams
821	Doran-Lindaas complex
903B2	Barnes-Langhei loams, 2 to 6 percent slopes, eroded
908	Bearden-Fargo complex
942C2	Langhei-Barnes loams, 6 to 12 percent slopes, eroded
942D2	Langhei-Barnes loams, 12 to 18 percent slopes, eroded
957B2	Rothsay-Zell silt loams, 2 to 6 percent slopes, eroded
969B	Zell-Rothsay silt loams, 1 to 4 percent slopes
969C2	Zell-Rothsay silt loams, 6 to 12 percent slopes, eroded
969D2	Zell-Rothsay silt loams, 12 to 18 percent slopes, eroded
987	Rockwell fine sandy loam, depressional
1029	Pits, gravel
1055	Haplaquolls and Histosols, ponded
1819	Glyndon silty clay loam
1871	Fargo silty clay, swales
1872	Fargo silty clay, silty substratum
1874	Lohnes sandy loam
1913C	Wahpeton-Cashel silty clays, 0 to 15 percent slopes
1916	Lindaas silt loam
1921	Foldahl very fine sandy loam
1944	Perella silty clay
1948	Fargo-Enloe complex
1971	Divide loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND



CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State

RAILROAD

DAMS

- Medium or small

PITS

- Gravel pit

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Other than bedrock (points down slope)

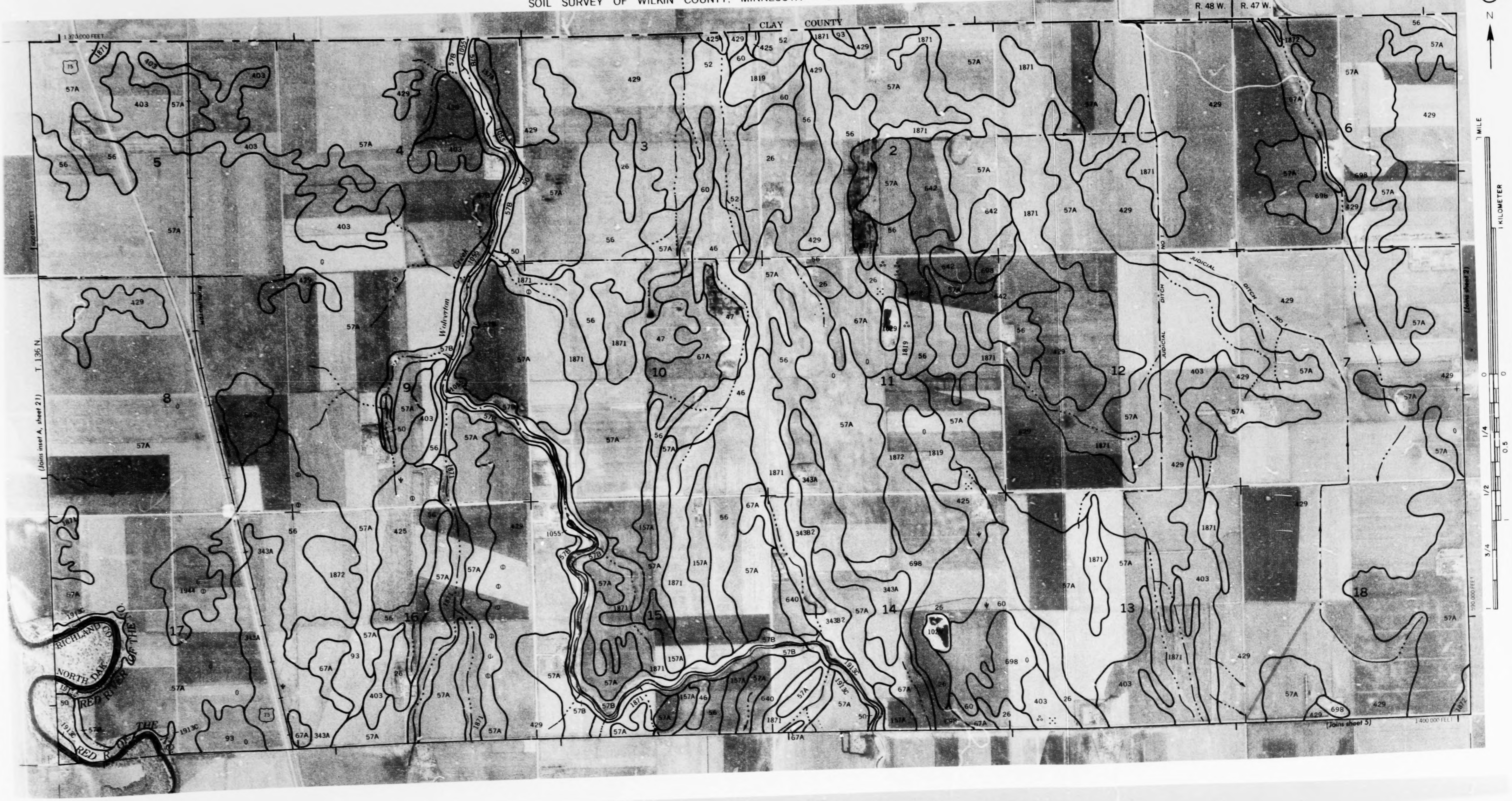
SHORT STEEP SLOPE

GULLY

MISCELLANEOUS

- Gravelly spot
- Saline spot
- Sandy spot
- Stony spot, very stony spot
- Calcareous spot
- Seep areas
- Overblown soil along fence

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 1


①
N
CLAY COUNTY
R. 48 W.
R. 47 W.
T. 136 N
1 370 000 FEET
1 400 000 FEET
550 000 FEET
(Joins inset A, sheet 21)
(Joins sheet 2)
(Joins sheet 5)
Wolverton Creek
JUDICIAL DITCH NO
RICHLAND CO.
NORTH DAKOTA
RED RIVER OF THE NORTH
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
1 MILE
KILOMETER
Scale 1:20000
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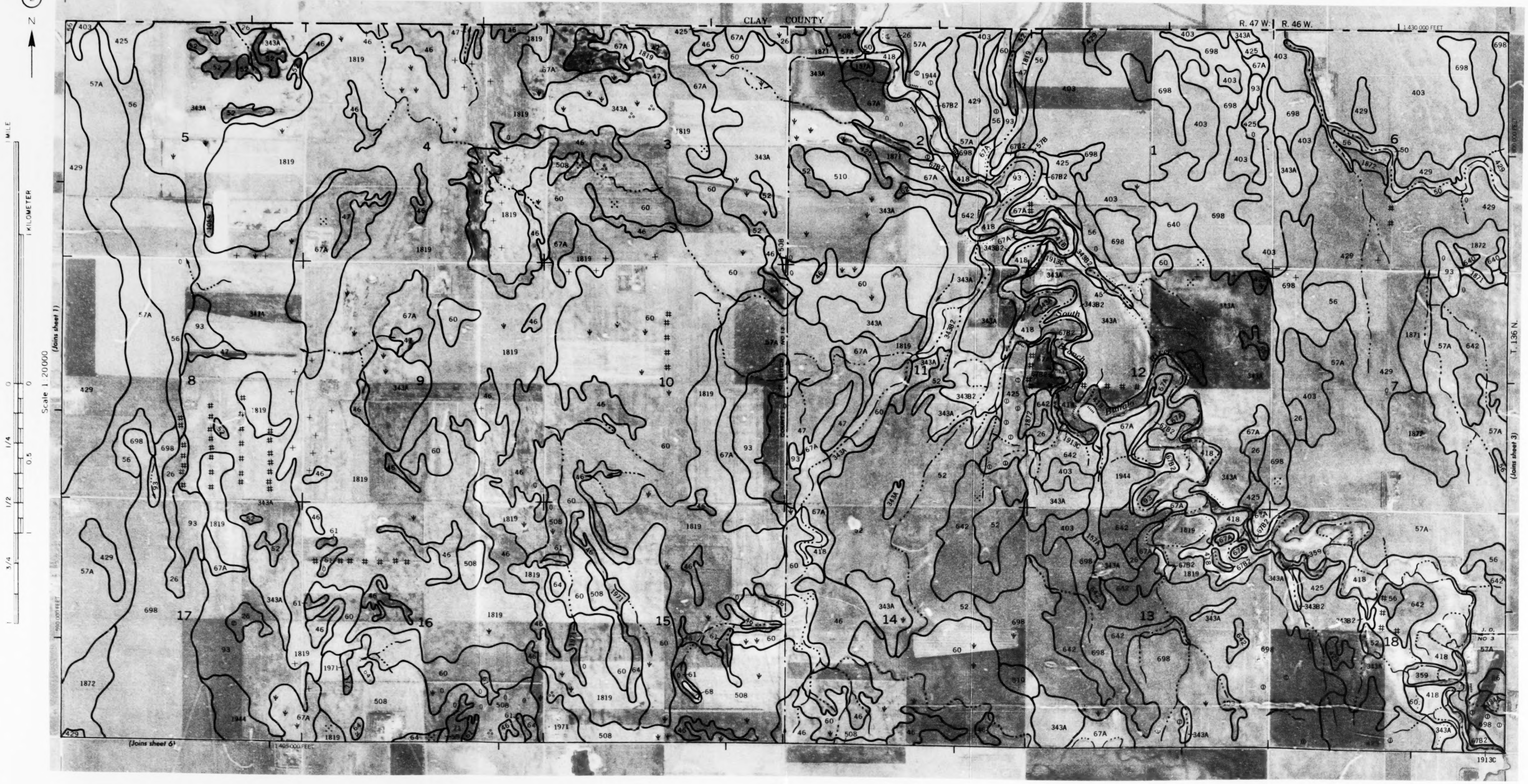
1/4
1/2
3/4
0.5

②

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 2


N
MILE
KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
CLAY COUNTY
R. 47 W.
R. 46 W.
T. 136 N.
1 430 000 FEET
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 6)
1 405 000 FEET
South Branch
J. D. NO 3
1
2
3
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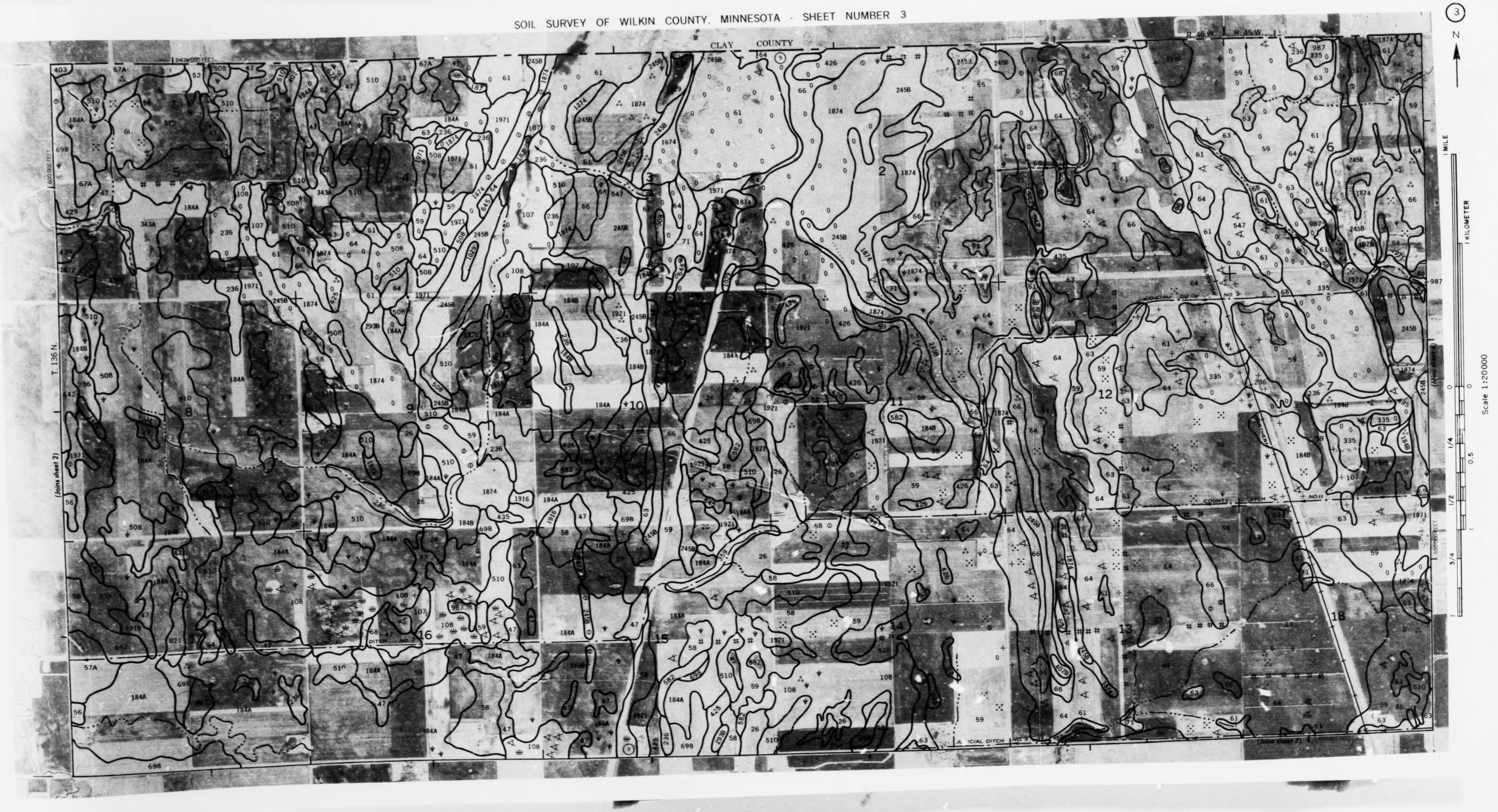
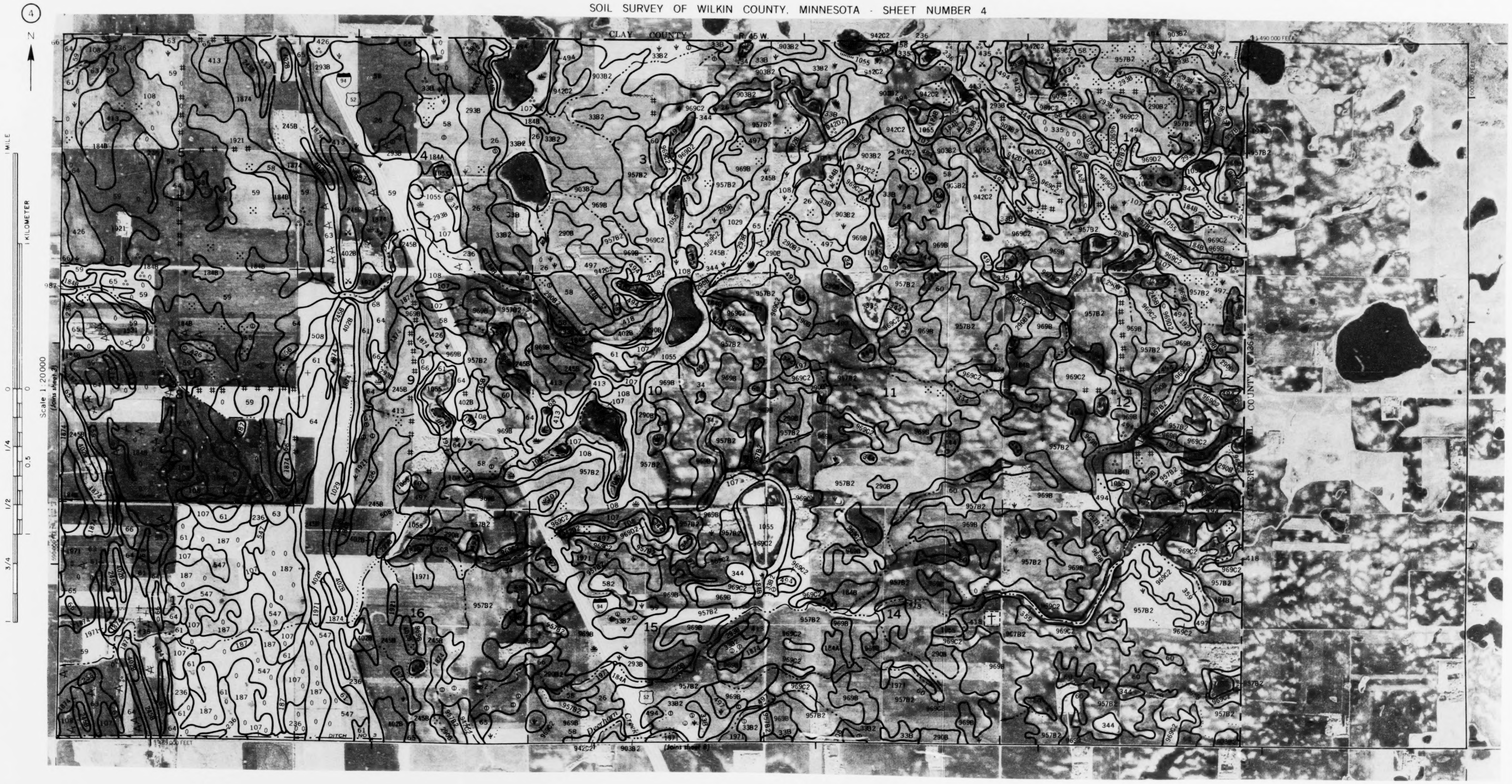
18

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 3

③


CLAY COUNTY
R. 46 W.
R. 45 W.
N
T. 136 N.
(Joins sheet 2)
(Joins sheet 7)
2 435 000 FEET
600 000 FEET
JUDICIAL DITCH NO. 3
COUNTY DITCH NO. 11
JUDICIAL DITCH NO. 3
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA · SHEET NUMBER 4


N
MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
CLAY COUNTY
R. 45 W.
(Joins sheet 3)
(Joins sheet 8)
1 490 000 FEET
COUNTY
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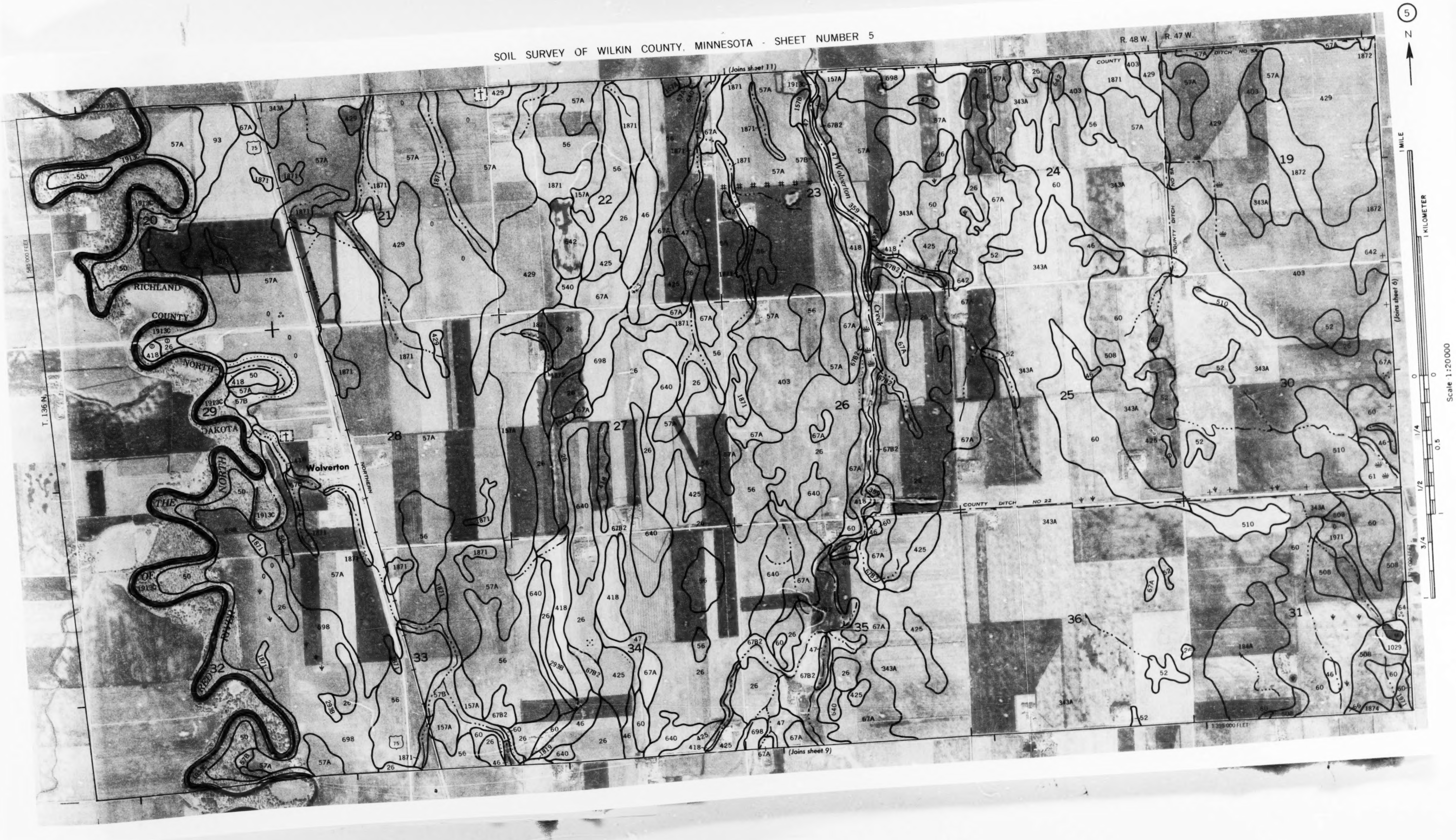
⑤

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 5


R. 48 W.
R. 47 W.
(Joins sheet 11)
(Joins sheet 9)
(Joins sheet 6)
T. 136 N.
N
RICHLAND
COUNTY
NORTH
DAKOTA
THE
RED
OF
THE
NORTH
Wolverton
Wolverton
Creek
NORTHERN
COUNTY DITCH NO 22
COUNTY DITCH NO 5A
75
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27
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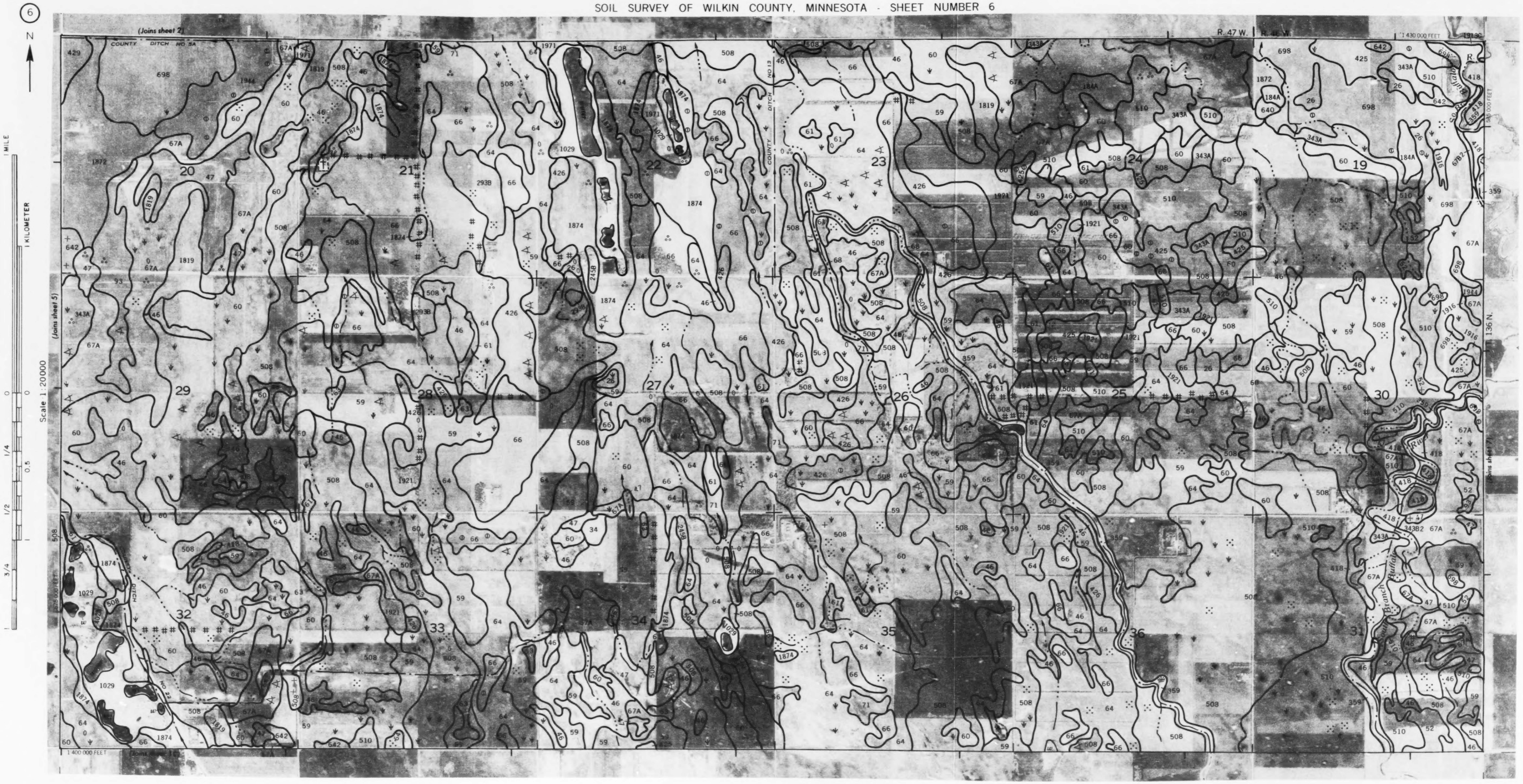
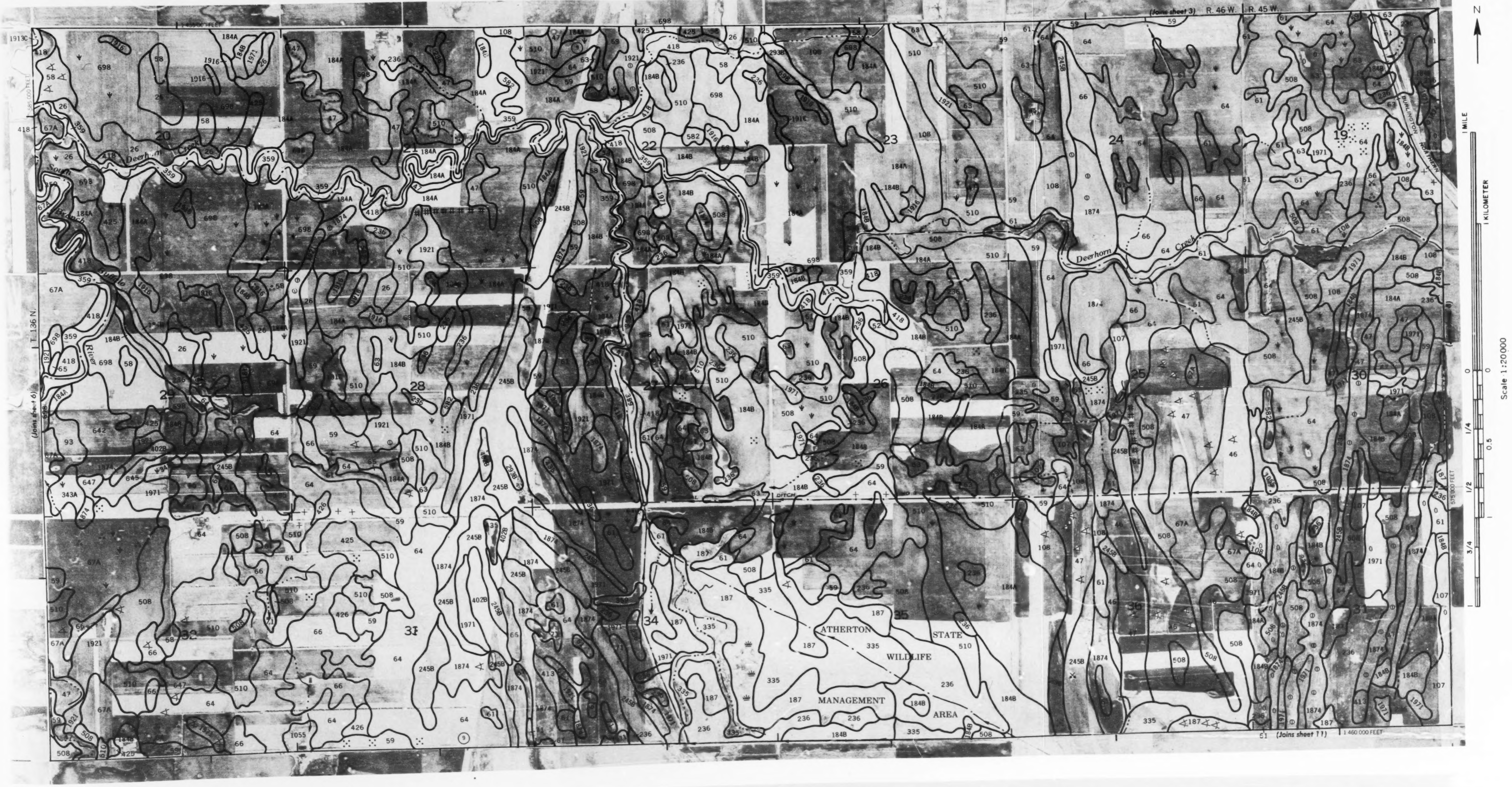
30
31
32
33
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 6

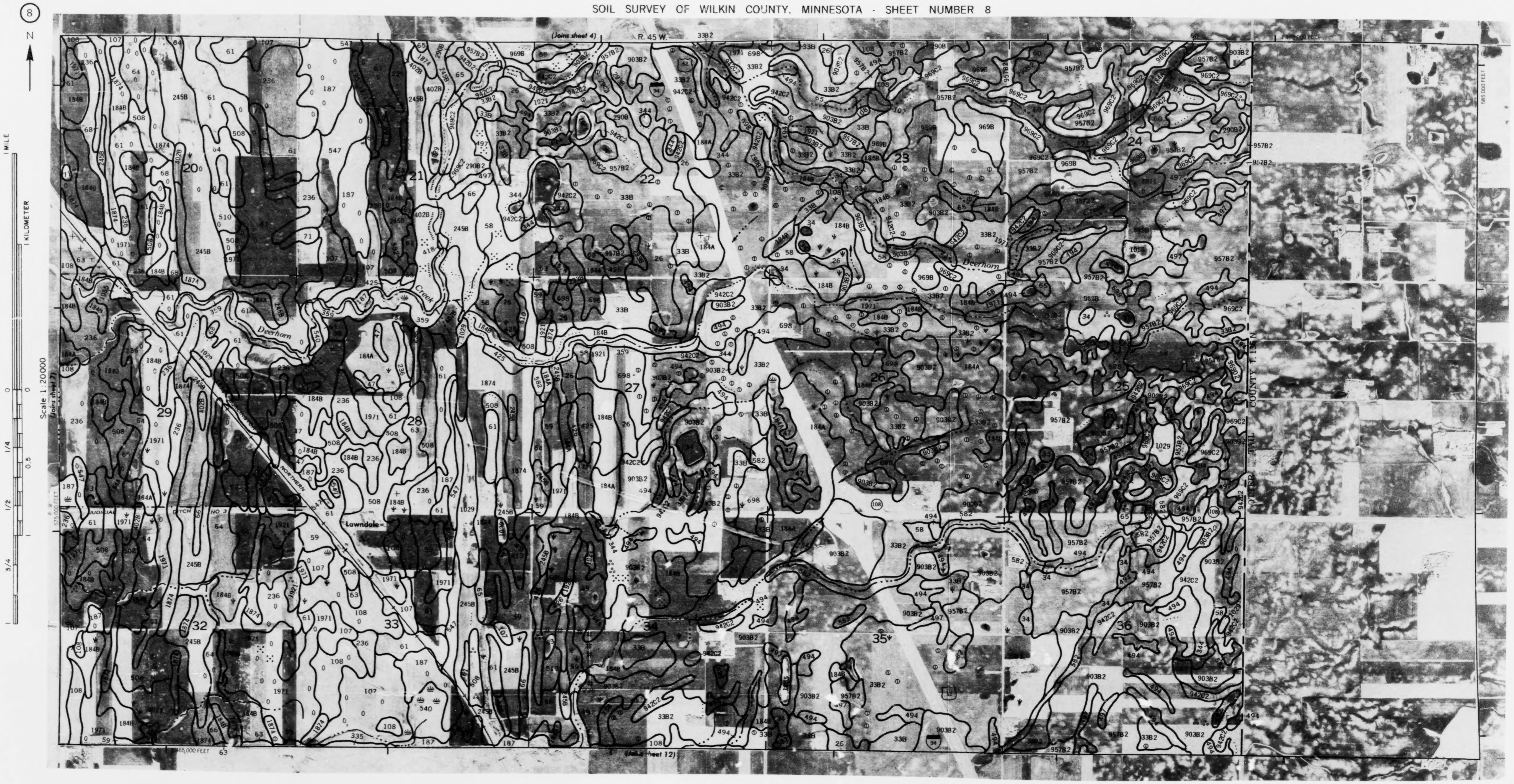

N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000
(Joins sheet 2)
(Joins sheet 5)
(Joins sheet 7)
COUNTY DITCH NO 5A
COUNTY DITCH NO 13
R. 47 W.
R. 46 W.
1 430 000 FEET
136 N.
1 400 000 FEET
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
South Branch Buffalo River
Rabbit R.

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 7

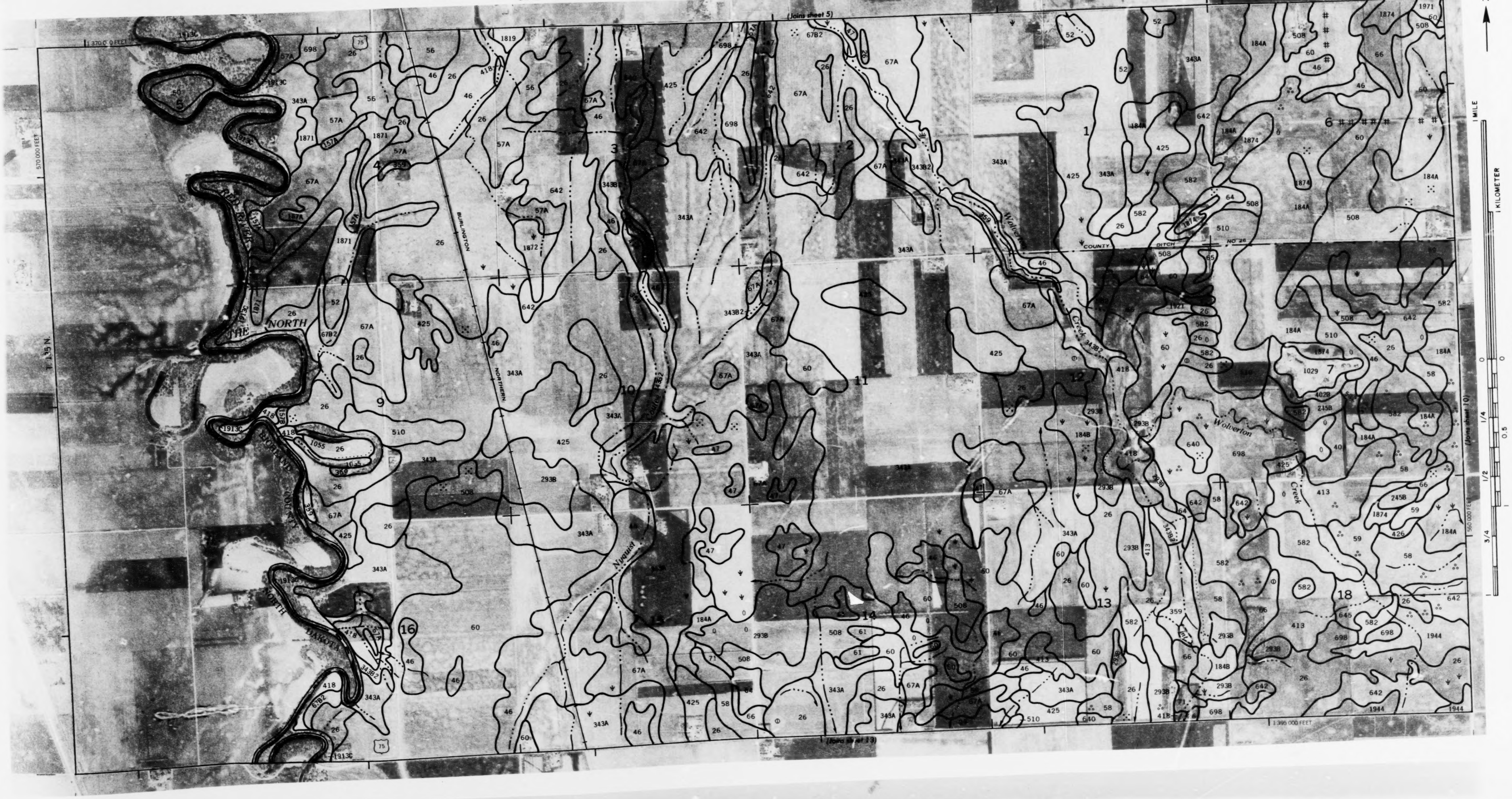

(Joins sheet 3)
R. 46 W.
R. 45 W.
T. 136 N.
(Joins sheet 6)
(Joins sheet 11)
Deerhorn Creek
River
DITCH
ATHERTON STATE WILDLIFE MANAGEMENT AREA
BURLINGTON NORTHERN
N
1 MILE
1 KILOMETER
Scale 1:20000
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

⑧

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 8

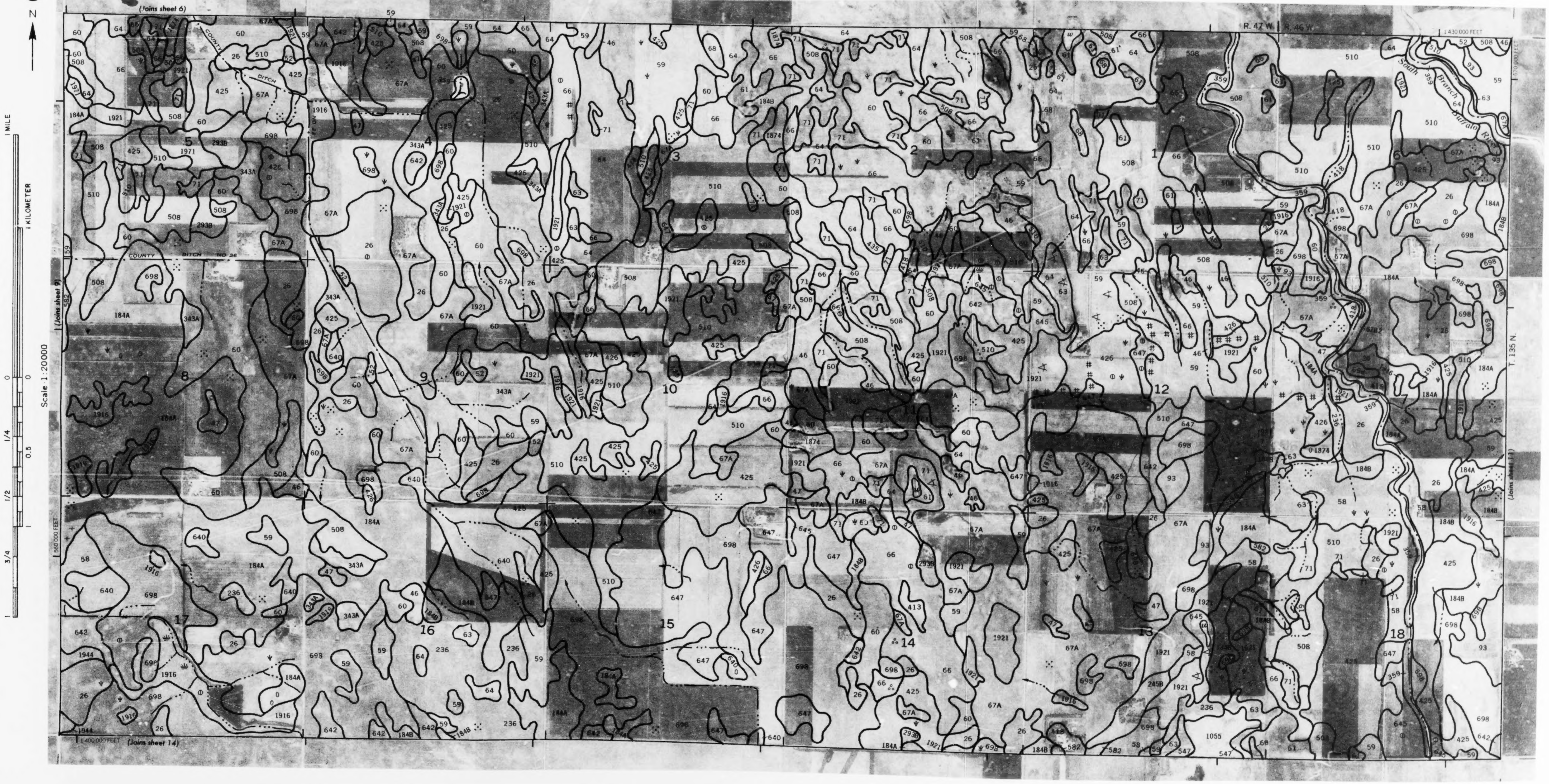

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
(Joins sheet 4)
R. 45 W.
(Joins sheet 7)
(Joins sheet 12)
575 000 FEET
565 000 FEET
585 000 FEET
Deerhorn
Creek
Lawndale
DITCH NO. 3
NORTHERN
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 9

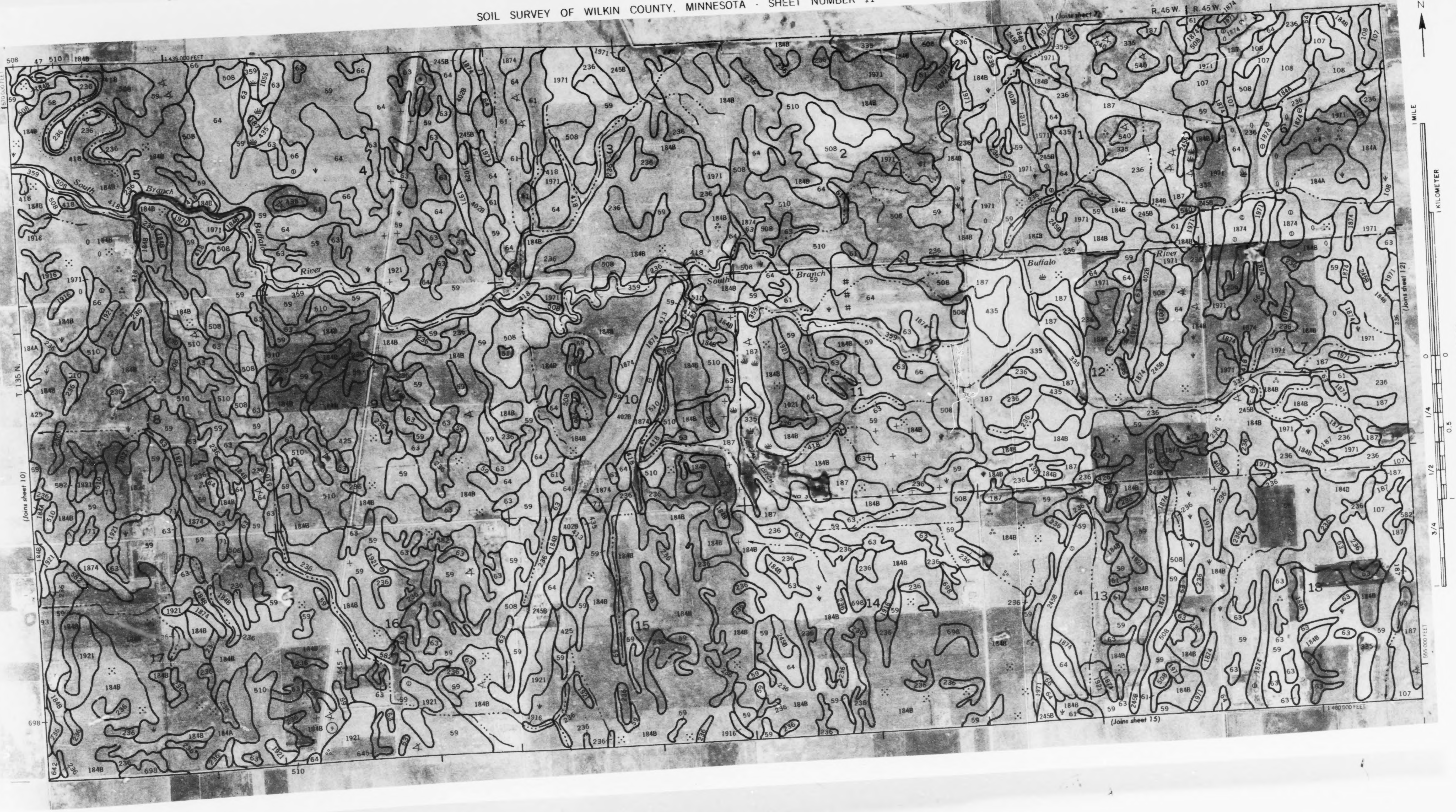

R. 48 W.
R. 47 W.
N
(Joins sheet 5)
(Joins sheet 10)
(Joins sheet 13)
T. 135 N.
1 370 000 FEET
570 000 FEET
560 000 FEET
1 395 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
RED RIVER OF THE NORTH
NORTH DAKOTA
BURLINGTON NORTHERN
Wolverton Creek
COUNTY DITCH NO 26
75
1
2
3
4
5
6
7
9
10
11
12
13
14
16
18

⑩

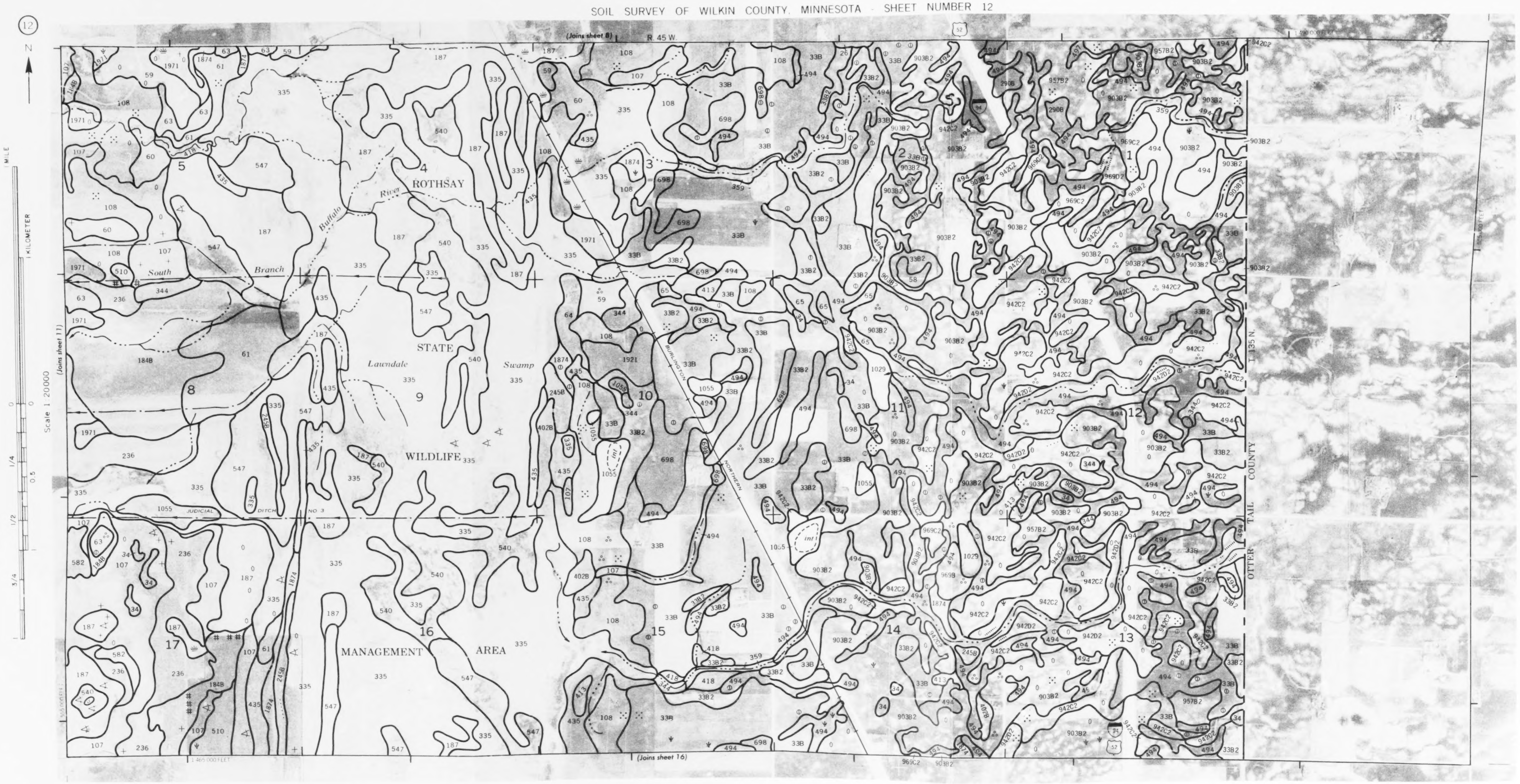
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 10


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
(Joins sheet 6)
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 14)
R. 47 W.
R. 46 W.
T. 135 N.
1 430 000 FEET
560 000 FEET
1 400 000 FEET
COUNTY DITCH NO 26
COUNTY DITCH
South Branch Buffalo River

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 11

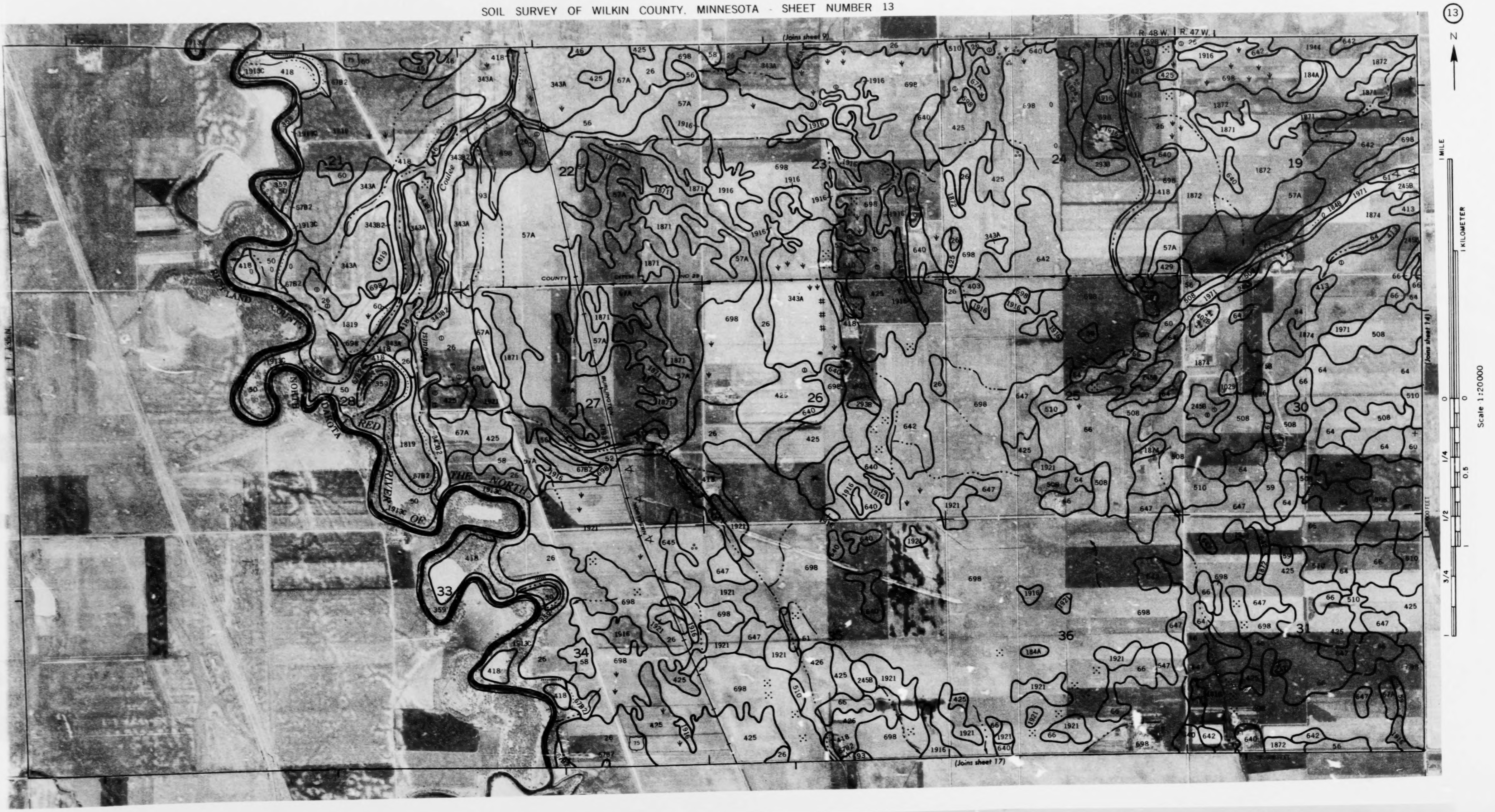

(Joins sheet 7)
R. 46 W.
R. 45 W.
T. 135 N.
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 15)
South Branch
Buffalo
River
South Branch
Buffalo
River
1 435 000 FEET
570 000 FEET
1 460 000 FEET
555 000 FEET
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0
0.5
Scale 1:20000

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA — SHEET NUMBER 12

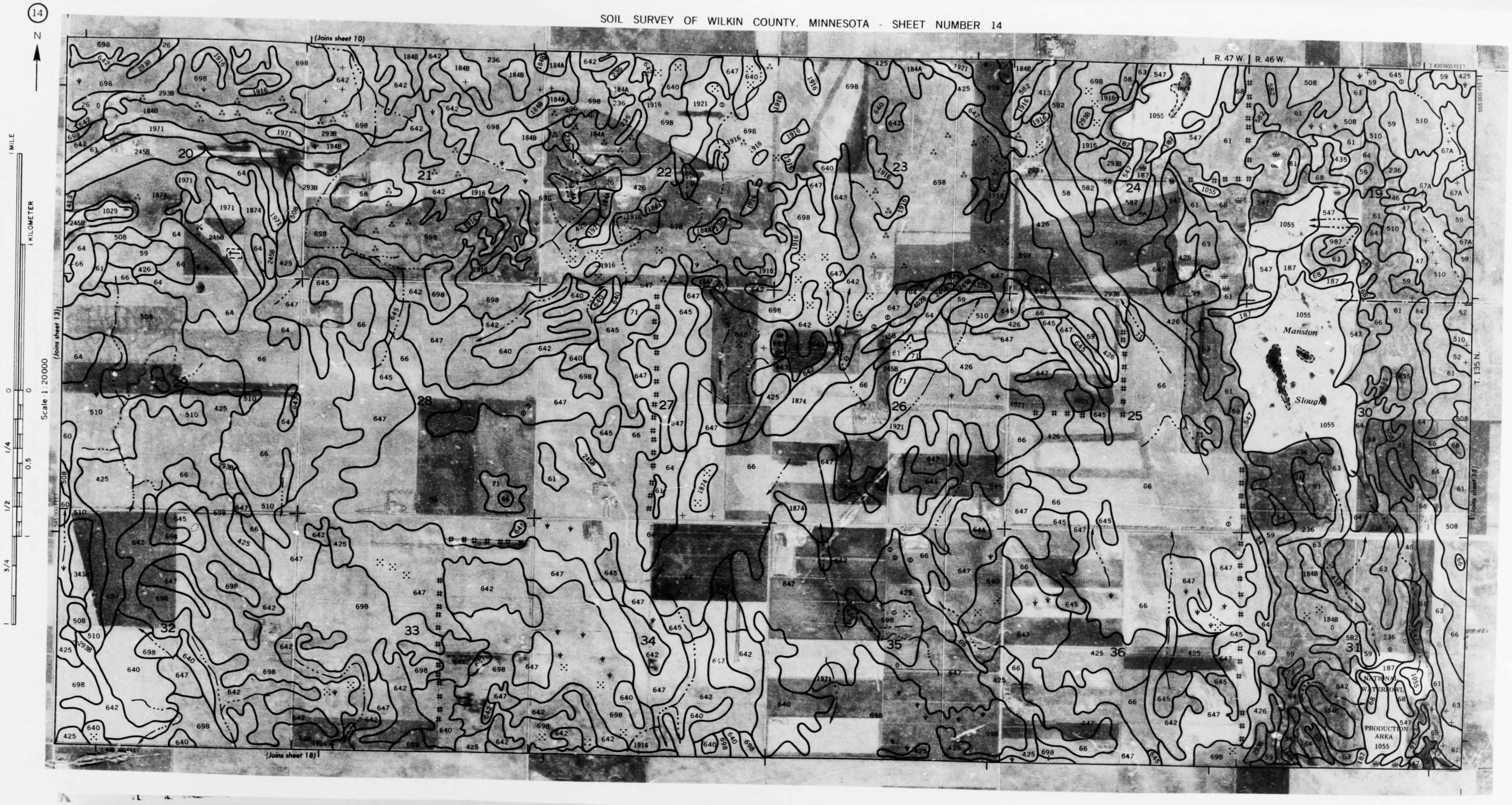

(12)
N
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
0.5
(Joins sheet 8)
R. 45 W.
(Joins sheet 11)
(Joins sheet 16)
T. 135 N.
OTTER TAIL COUNTY
ROTHSAY
STATE
WILDLIFE
MANAGEMENT
AREA
Lawndale
Swamp
Buffalo River
South Branch
JUDICIAL DITCH NO 3
BURLINGTON NORTHERN
1 465 000 FEET
52
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

best copy available

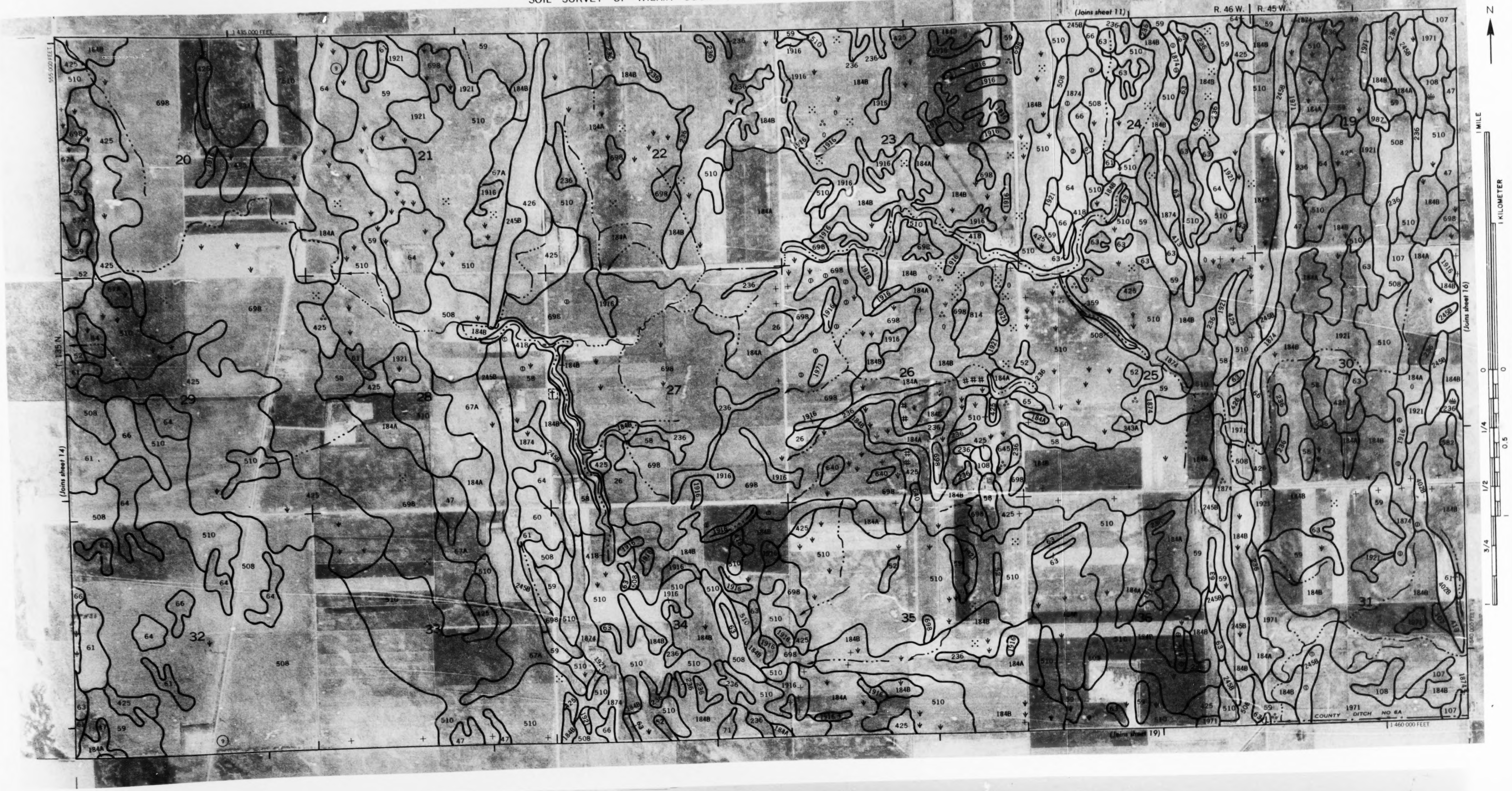
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 13


(Joins sheet 9)
R. 48 W.
R. 47 W.
(Joins sheet 14)
(Joins sheet 17)
N
21
22
23
24
19
27
26
25
30
28
33
34
36
31
RED
RIVER
OF
THE
NORTH
DAKOTA
Coulee
COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

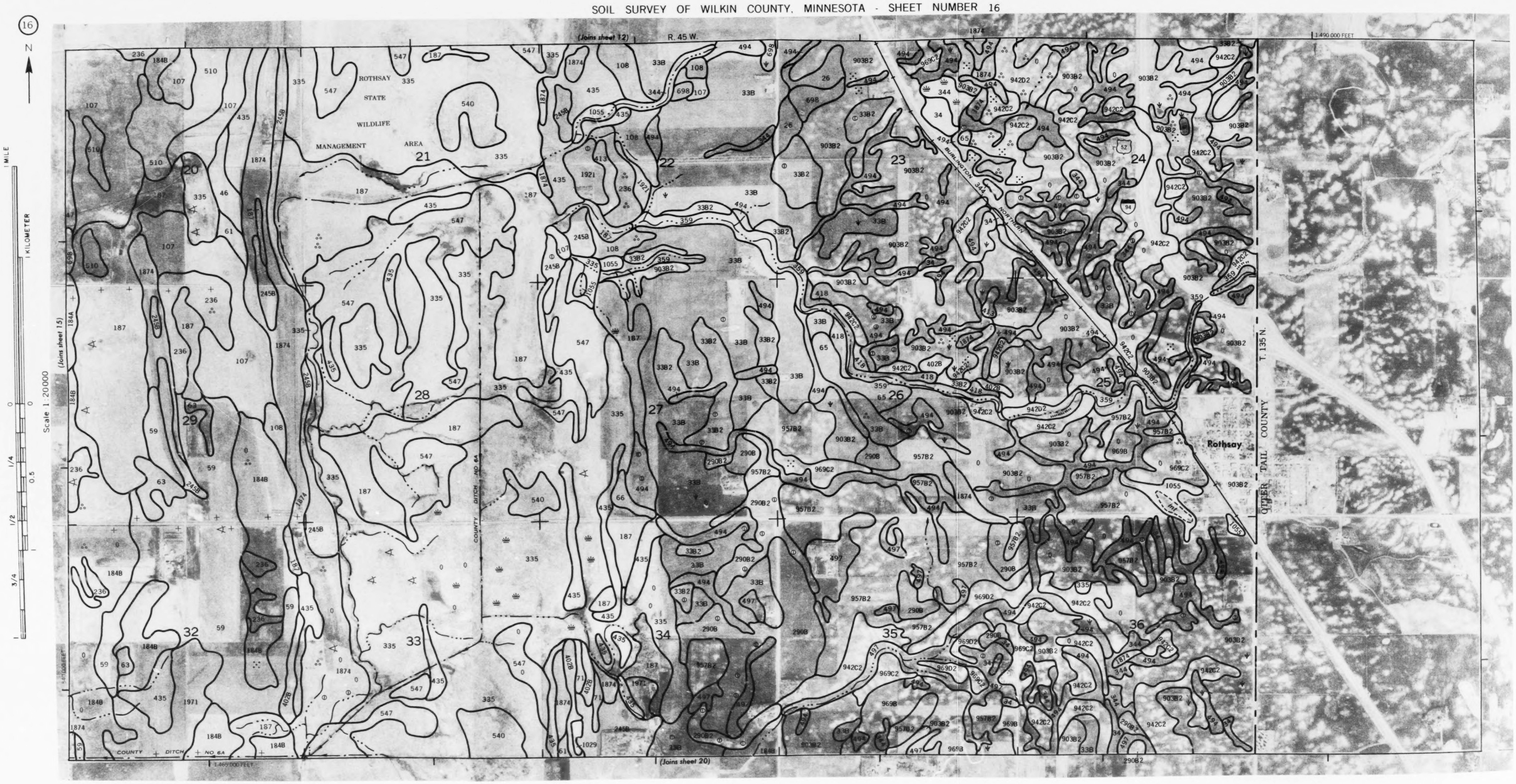
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 14


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
(Joins sheet 10)
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 18)
R. 47 W.
R. 46 W.
T. 135 N.
1 430 000 FEET
555 000 FEET
20
21
22
23
24
19
25
26
27
28
29
30
31
32
33
34
35
36
Manston
Slough
NATIONAL WATERFOWL PRODUCTION AREA
1055

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 15

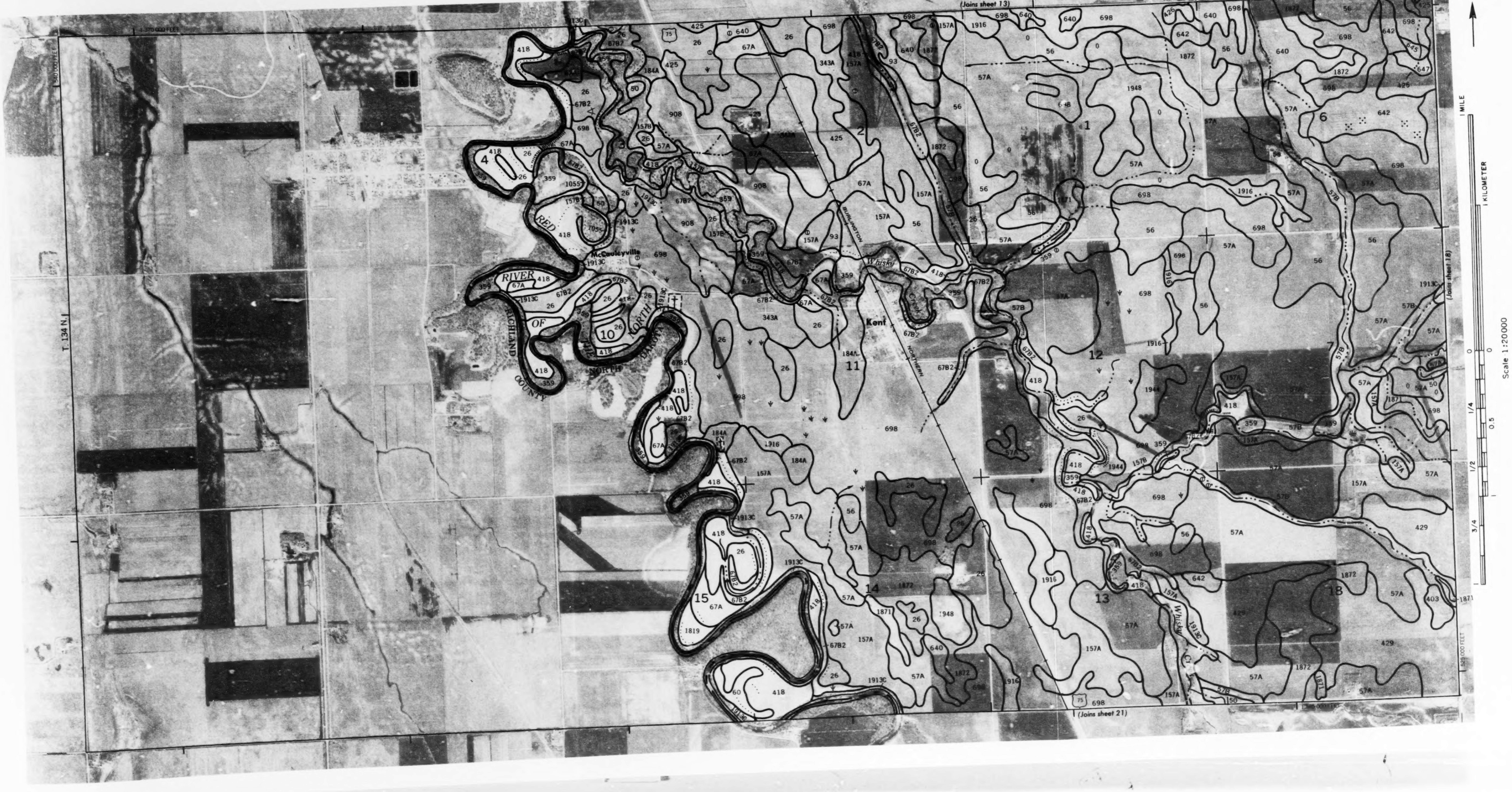

(Joins sheet 11)
R. 46 W. | R. 45 W.
1 435 000 FEET
T. 135 N.
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 19)
1 460 000 FEET
COUNTY DITCH NO 6A
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000
20
21
22
23
24
19
29
28
27
26
25
30
32
33
34
35
36
31

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 16

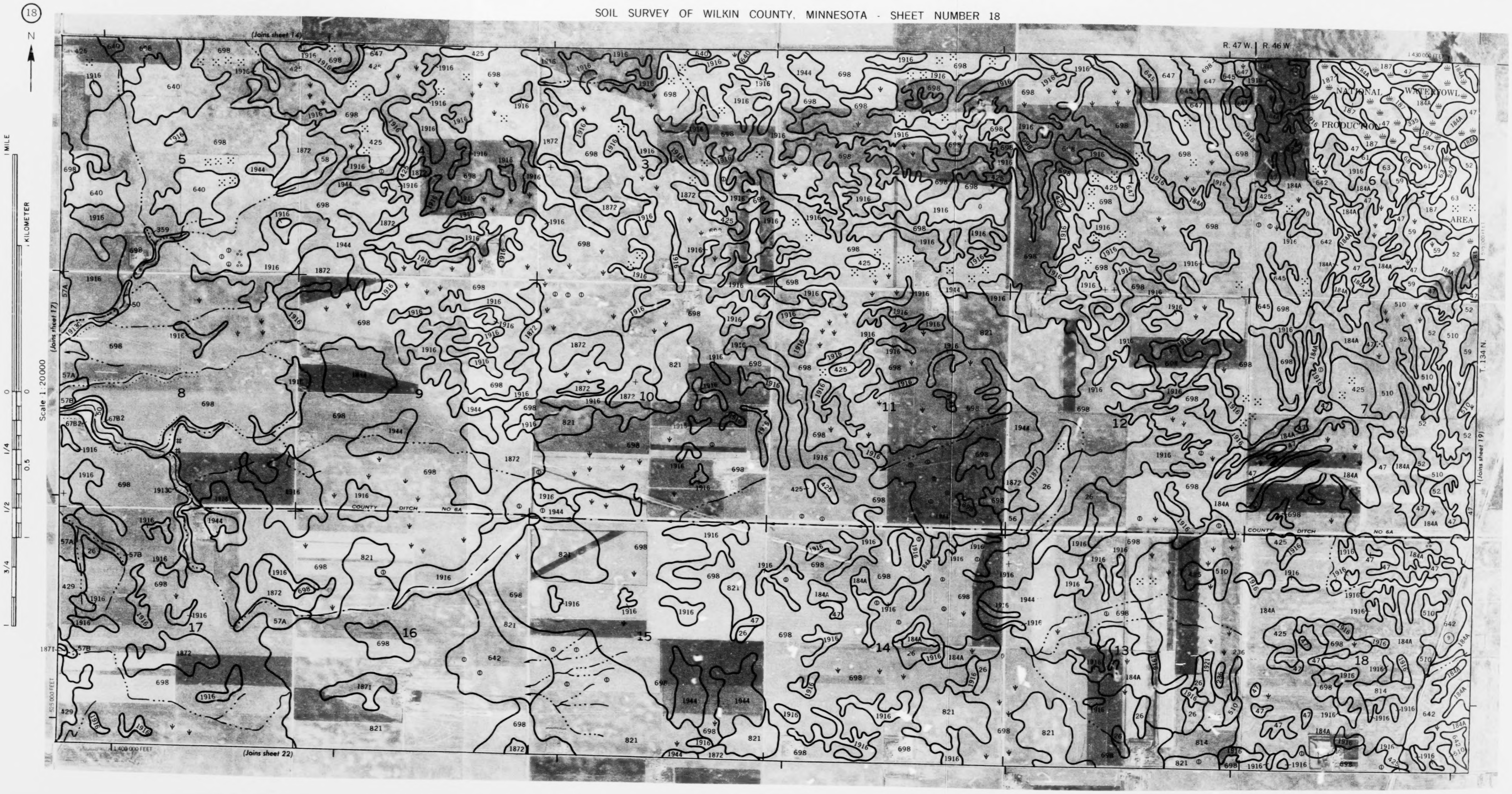

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
(Joins sheet 12)
R. 45 W.
(Joins sheet 15)
(Joins sheet 20)
1 490 000 FEET
1 460 000 FEET
ROTHSAY STATE WILDLIFE MANAGEMENT AREA
COUNTY DITCH NO 6A
COUNTY DITCH NO 6A
BURLINGTON NORTHERN
Rothsay
OTTER TAIL COUNTY
T. 135 N.
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

⑰

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 17

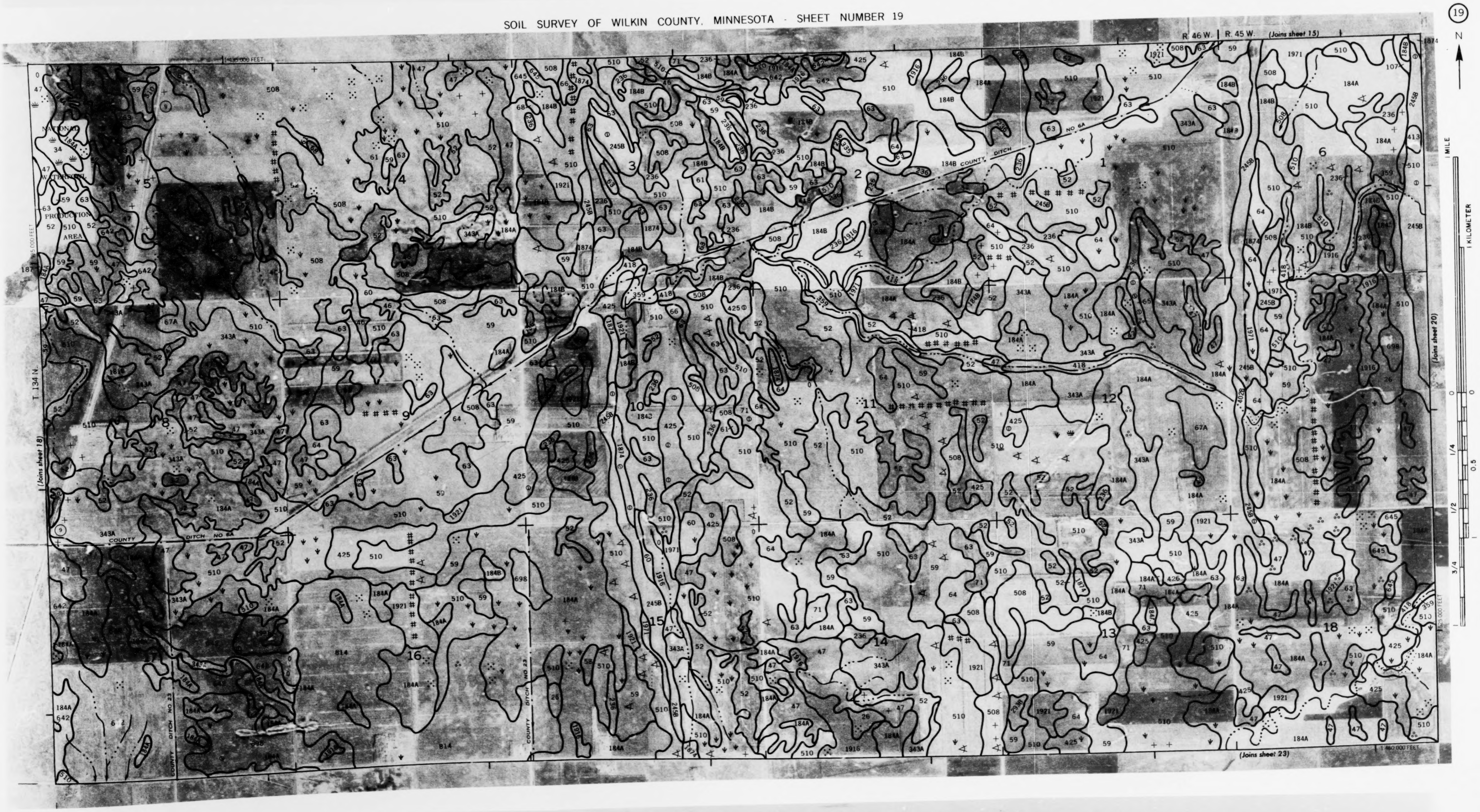

(Joins sheet 13)
(Joins sheet 21)
(Joins sheet 18)
R. 48 W. | R. 47 W.
T. 134 N.
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
McCauleyville
Kent
RED
RIVER
OF
THE
NORTH
NORTH
DAKOTA
RICHLAND
COUNTY
Whisky
Creek
BURLINGTON
NORTHERN
75
1
2
4
6
7
10
11
12
13
14
15
18
57A
698
1916
1872
56
640
642
425
26
67A
67B2
418
359
157A
157B
1913C
343A
184A
908
93
1944
1948
1871
1819
429
403
60
50
645
647
0

⑱ SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 18

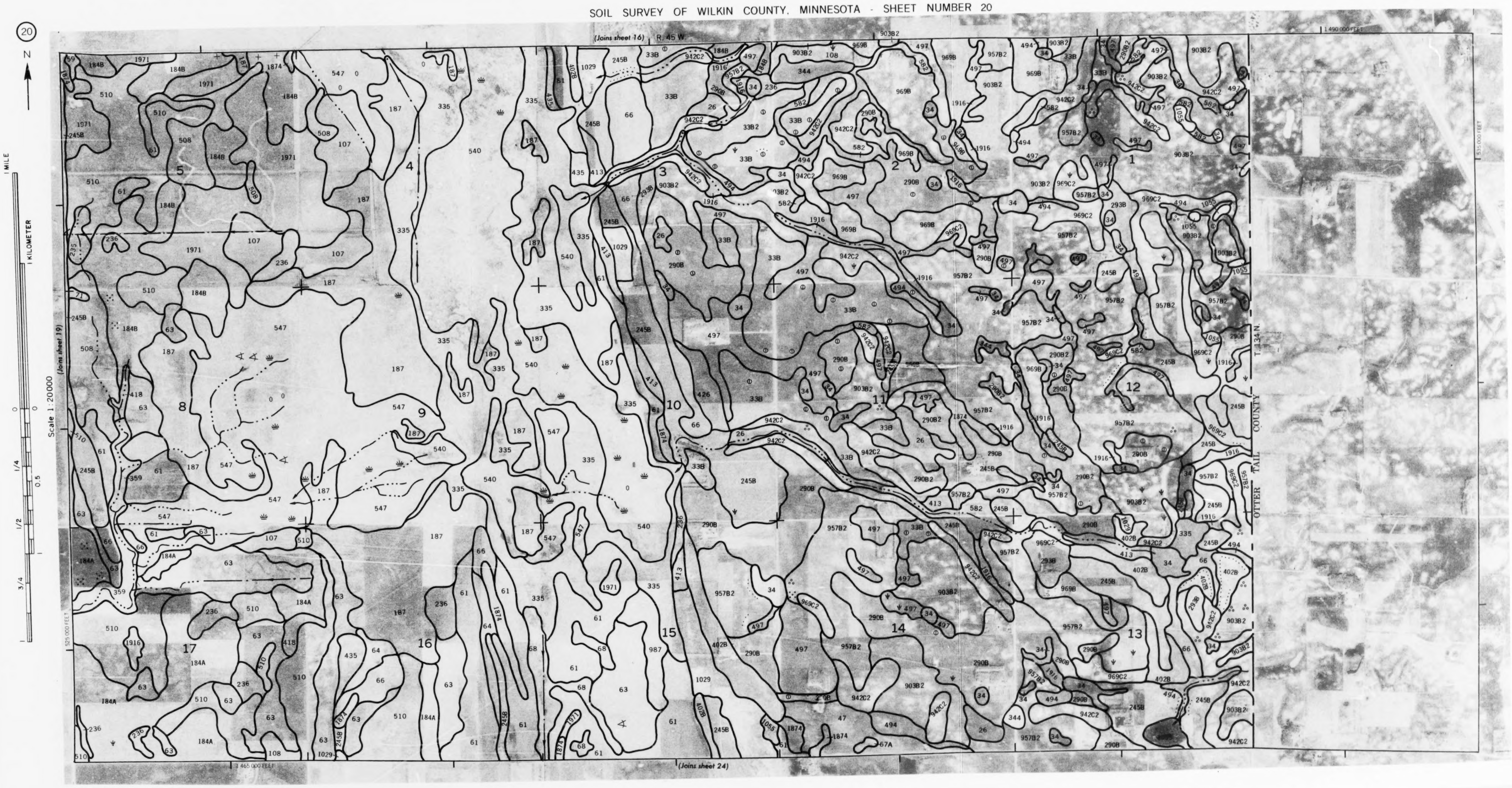

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 14)
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 22)
R. 47 W.
R. 46 W.
T. 134 N.
NATIONAL WATERFOWL PRODUCTION AREA
COUNTY DITCH NO 6A
1 430 000 FEET
1 400 000 FEET
525 000 FEET
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 19

⑲


R. 46 W.
R. 45 W.
(Joins sheet 15)
(Joins sheet 20)
(Joins sheet 23)
(Joins sheet 18)
T. 134 N.
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0
0.5
1
NATIONAL WATERFOWL PRODUCTION AREA
COUNTY DITCH NO 6A
COUNTY DITCH NO 23

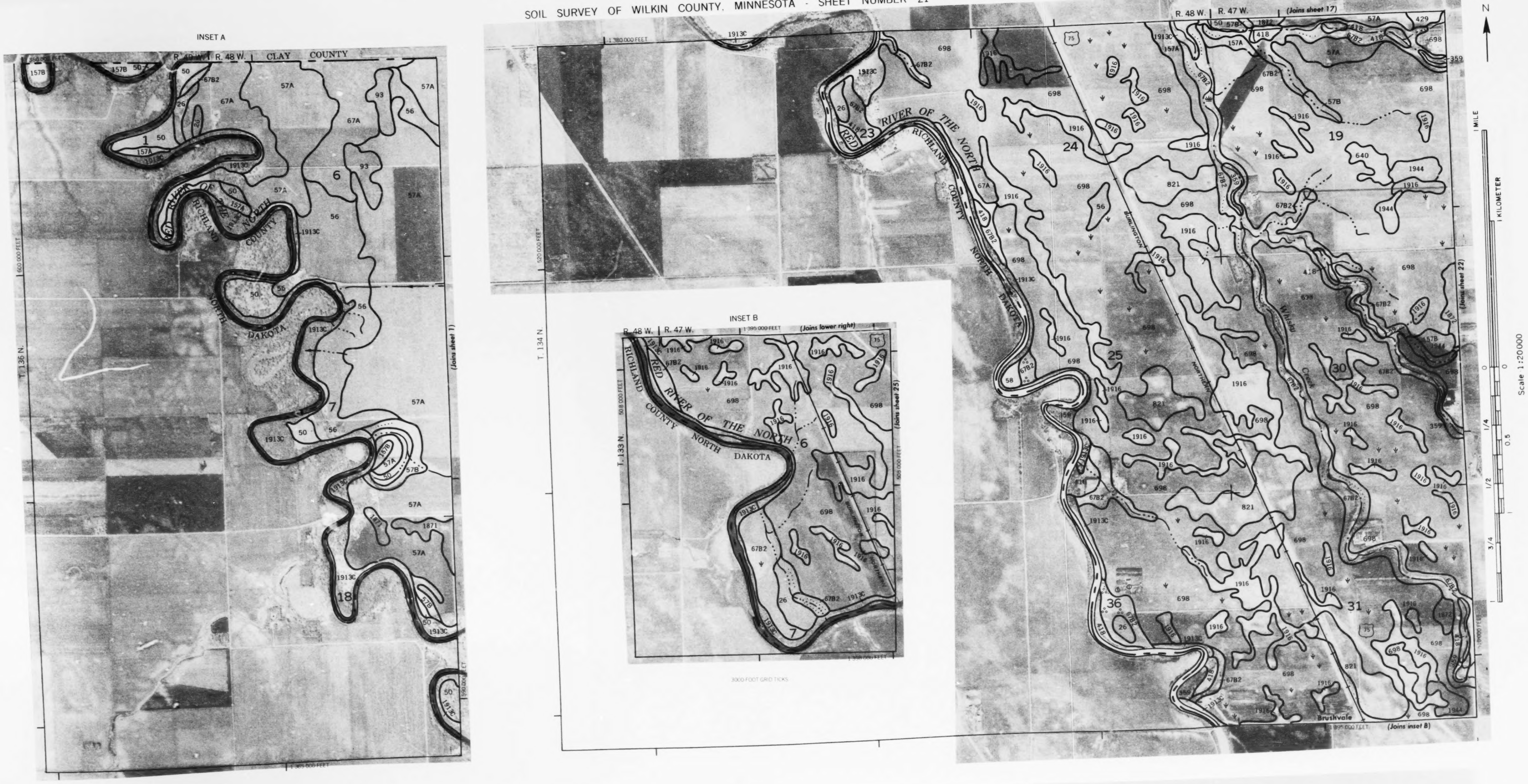
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 20


⑳
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 16)
R. 45 W.
(Joins sheet 19)
(Joins sheet 24)
T. 134 N.
OTTER TAIL COUNTY
1 490 000 FEET
525 000 FEET
3 465 000 FEET
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

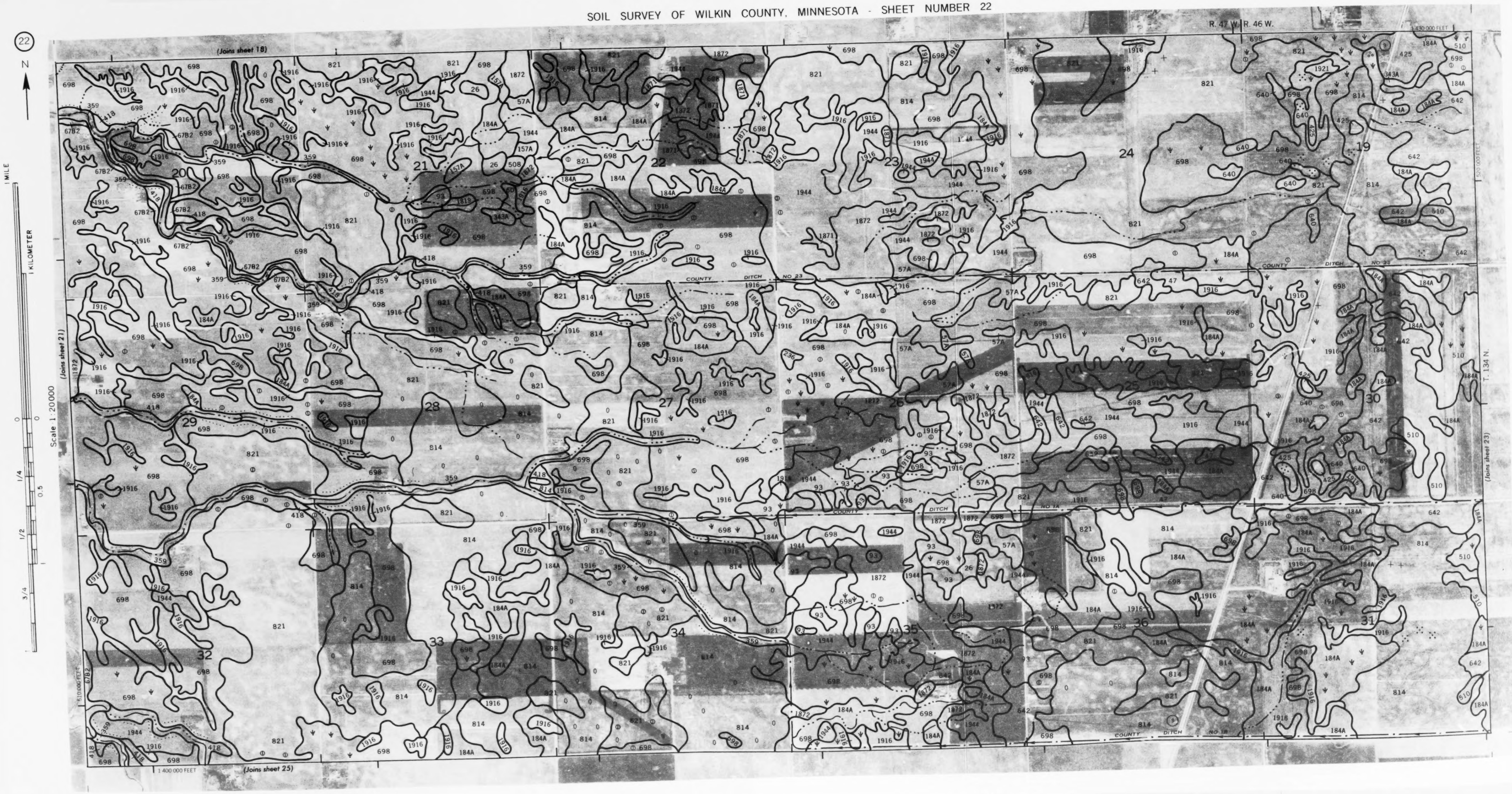
WILKIN COUNTY, MINNESOTA NO. 20

WILKIN COUNTY, MINNESOTA NO. 21

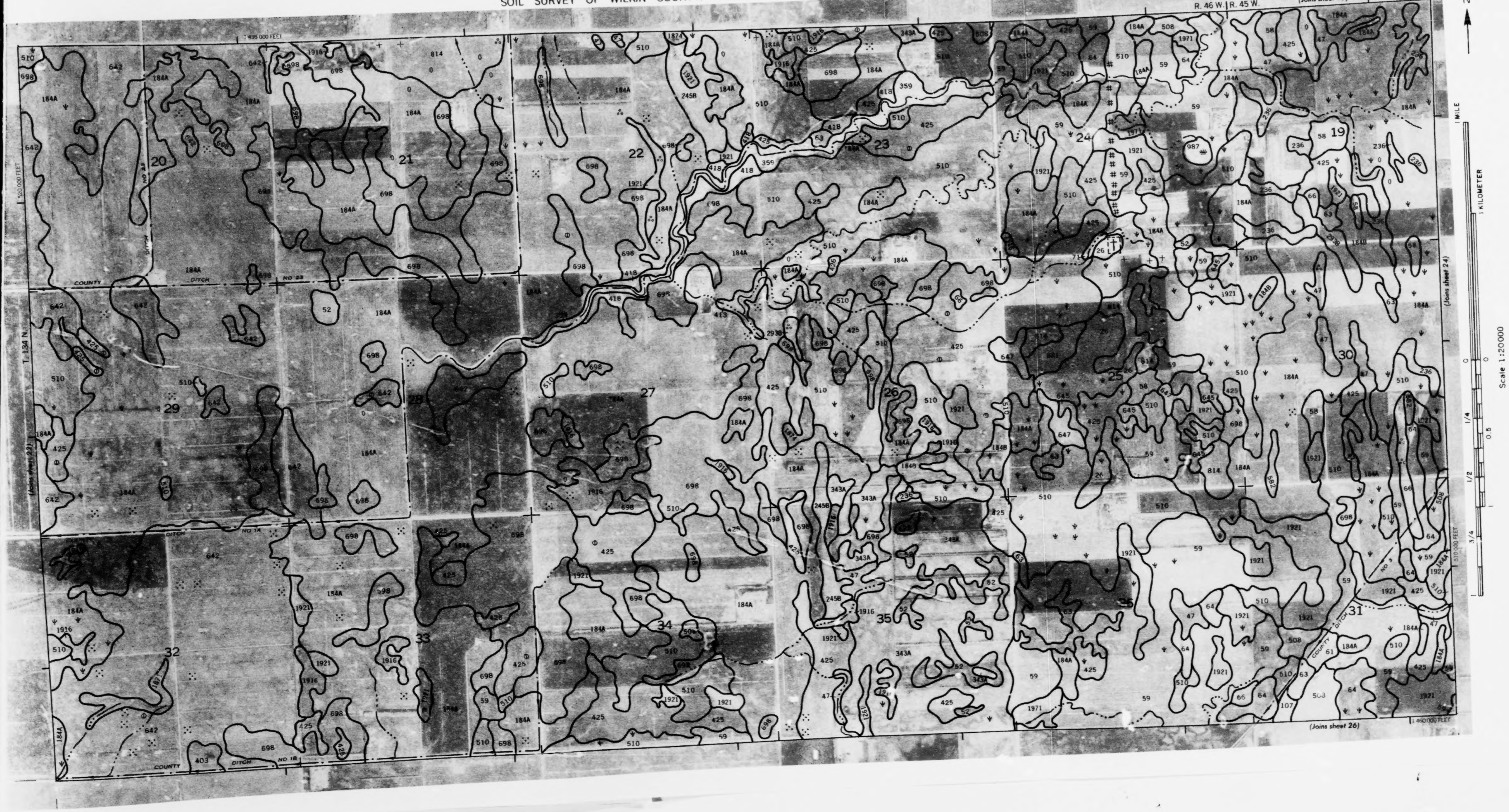
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 21


INSET A
R. 49 W.
R. 48 W.
CLAY COUNTY
RED RIVER OF THE NORTH
RICHLAND COUNTY
NORTH DAKOTA
T. 136 N.
600 000 FEET
(Joins sheet 1)
1
6
7
18
R. 48 W.
R. 47 W.
(Joins sheet 17)
1 380 000 FEET
520 000 FEET
T. 134 N.
23
24
25
19
30
31
36
Whiskey Creek
Brushvale
(Joins sheet 22)
(Joins inset B)
INSET B
(Joins lower right)
(Joins sheet 25)
T. 133 N.
6
7
3000 FOOT GRID TICKS
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1
157B
157A
50
26
67B2
67A
57A
57B
93
56
1913C
1871
698
1916
821
640
1944
418
429
359
58

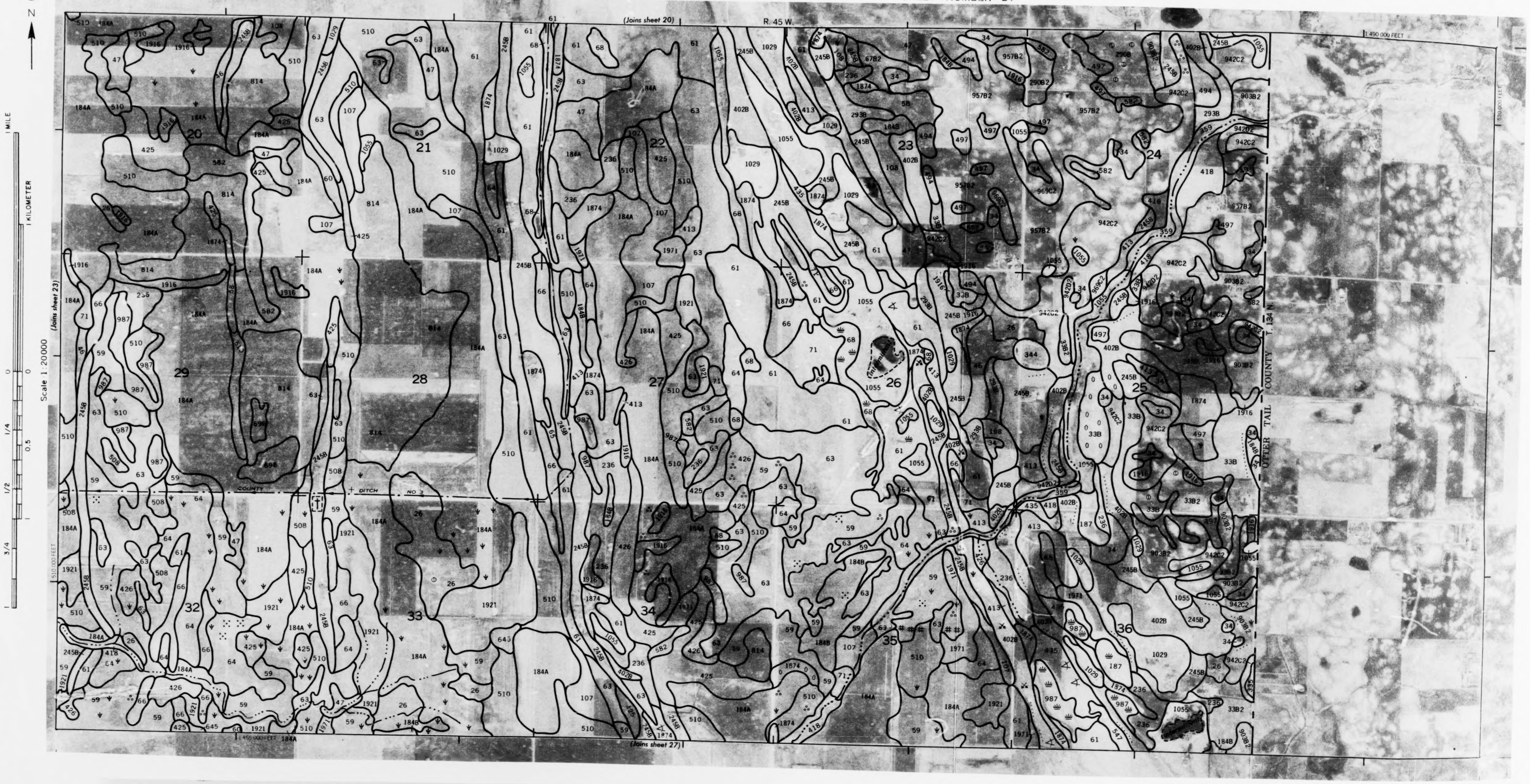
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 22


22
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1
(Joins sheet 18)
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 25)
R. 47 W.
R. 46 W.
T. 134 N.
430 000 FEET
1 400 000 FEET
COUNTY DITCH NO 23
COUNTY DITCH NO 18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

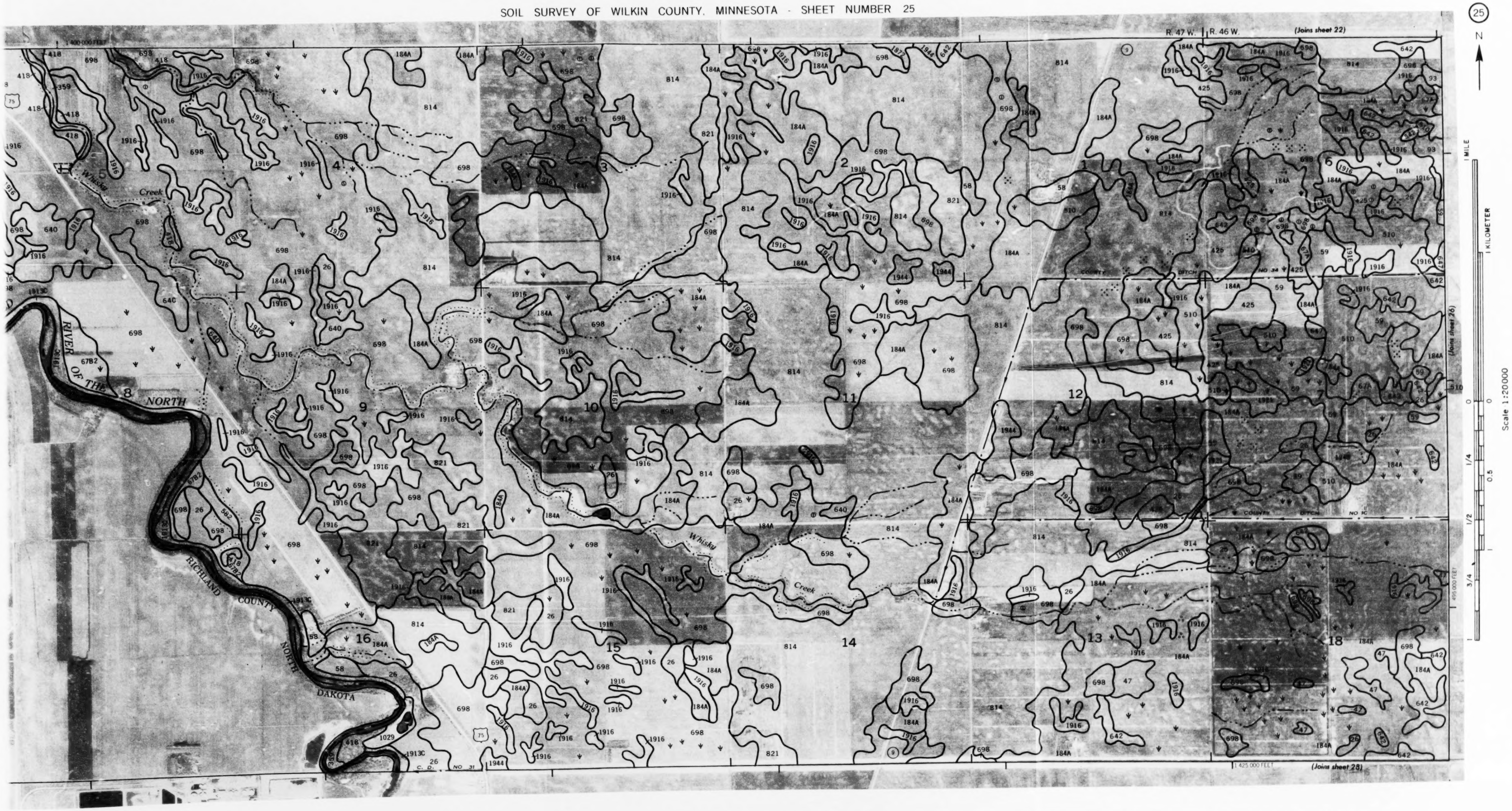
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 23


R. 46 W. | R. 45 W.
(Joins sheet 19)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 22)
T. 134 N.
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
435 000 FEET
500 000 FEET
510 000 FEET
1 460 000 FEET
COUNTY DITCH NO 23
DITCH NO 14
COUNTY DITCH NO 18
COUNTY DITCH NO 3
20
21
22
23
24
19
29
28
27
26
25
30
32
33
34
35
36
31

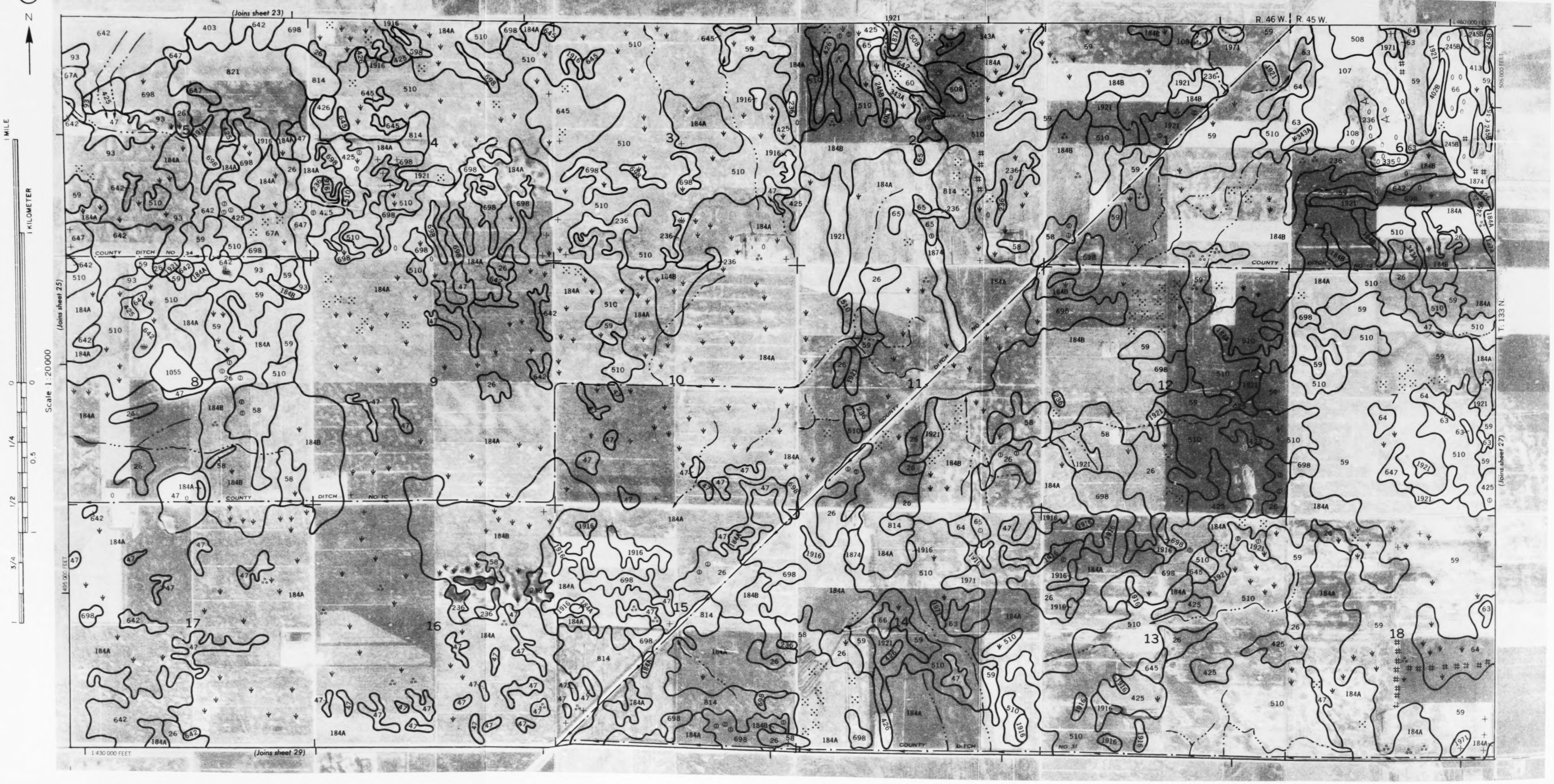
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 24


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
(Joins sheet 20)
R. 45 W.
(Joins sheet 23)
(Joins sheet 27)
T. 134 N.
OTTER TAIL COUNTY
COUNTY
DITCH
NO. 3
1 490 000 FEET
1 460 000 FEET
510 000 FEET
530 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

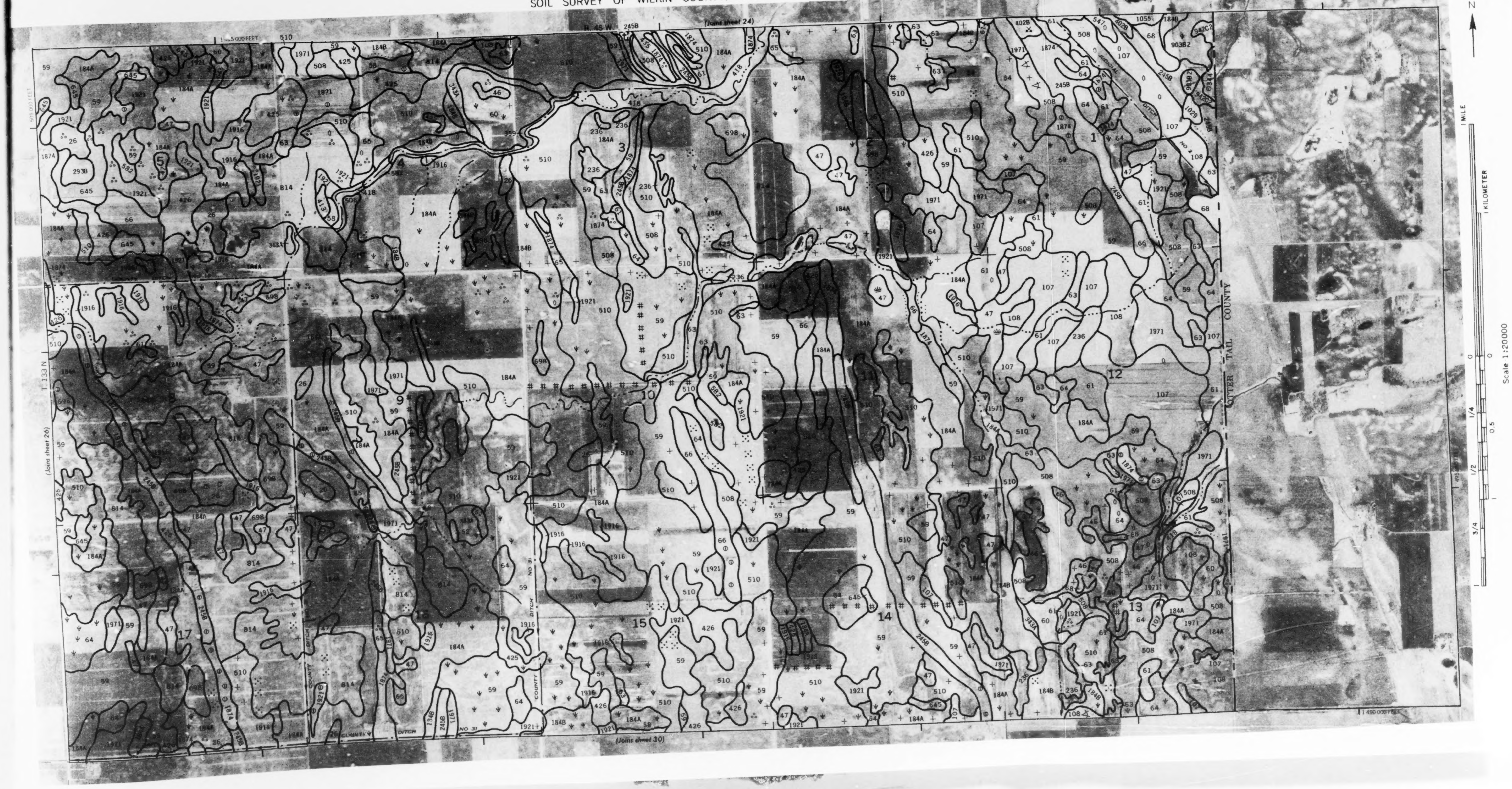
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 25


1 400 000 FEET
R. 47 W.
R. 46 W.
(Joins sheet 22)
N
(Joins sheet 26)
(Joins sheet 28)
1 425 000 FEET
495 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
RIVER OF THE NORTH
RICHLAND COUNTY
NORTH DAKOTA
Whiskey Creek
Whiskey Creek
COUNTY DITCH NO 34
COUNTY DITCH NO 10
C. D. NO 31
75
9
1
2
3
4
5
6
8
9
10
11
12
13
14
15
16
18
418
359
698
1916
184A
814
821
640
64C
26
58
510
425
59
642
93
47
1944
6782
1029
1913C

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 26

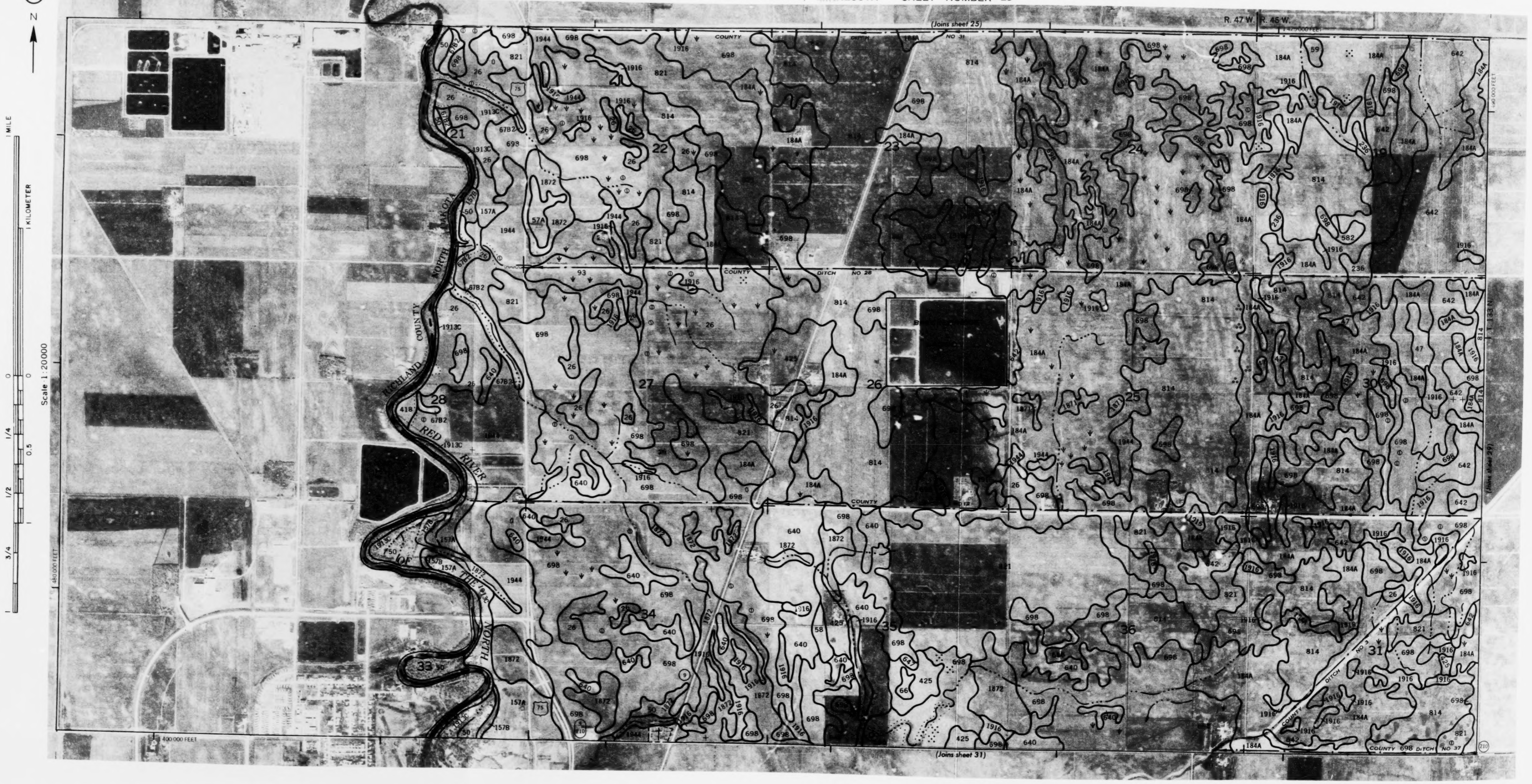

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 29)
R. 46 W.
R. 45 W.
T. 133 N.
1 460 000 FEET
505 000 FEET
495 000 FEET
1 430 000 FEET
COUNTY DITCH NO 34
COUNTY DITCH NO 11
COUNTY DITCH NO 31
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 27

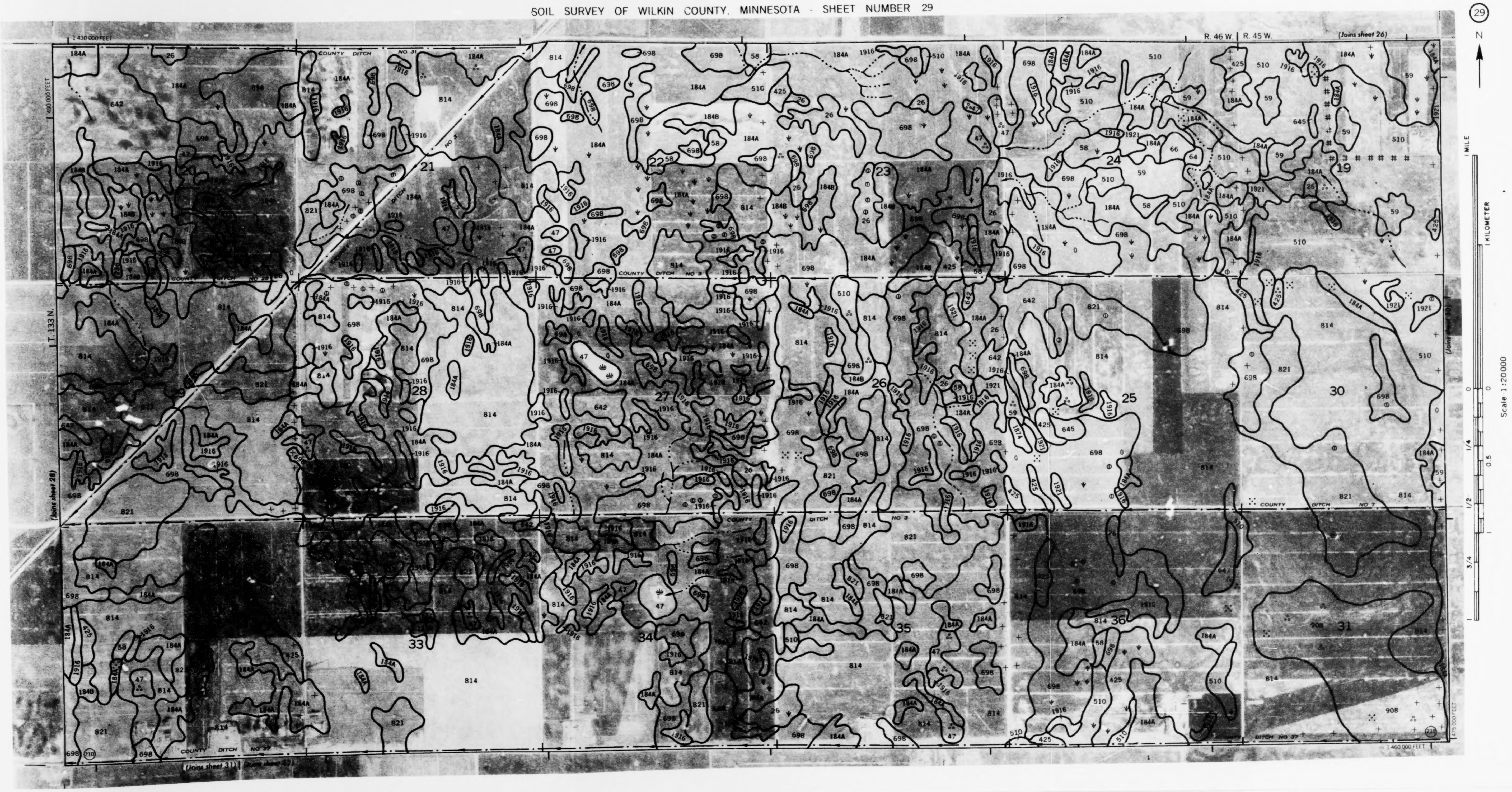

(Joins sheet 24)
R. 45 W.
1 465 000 FEET
T. 133 N.
(Joins sheet 26)
(Joins sheet 30)
OTTER TAIL COUNTY
COUNTY DITCH
NO 31
1 490 000 FEET
1
2
3
4
5
9
10
12
13
14
15
17
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

㉘

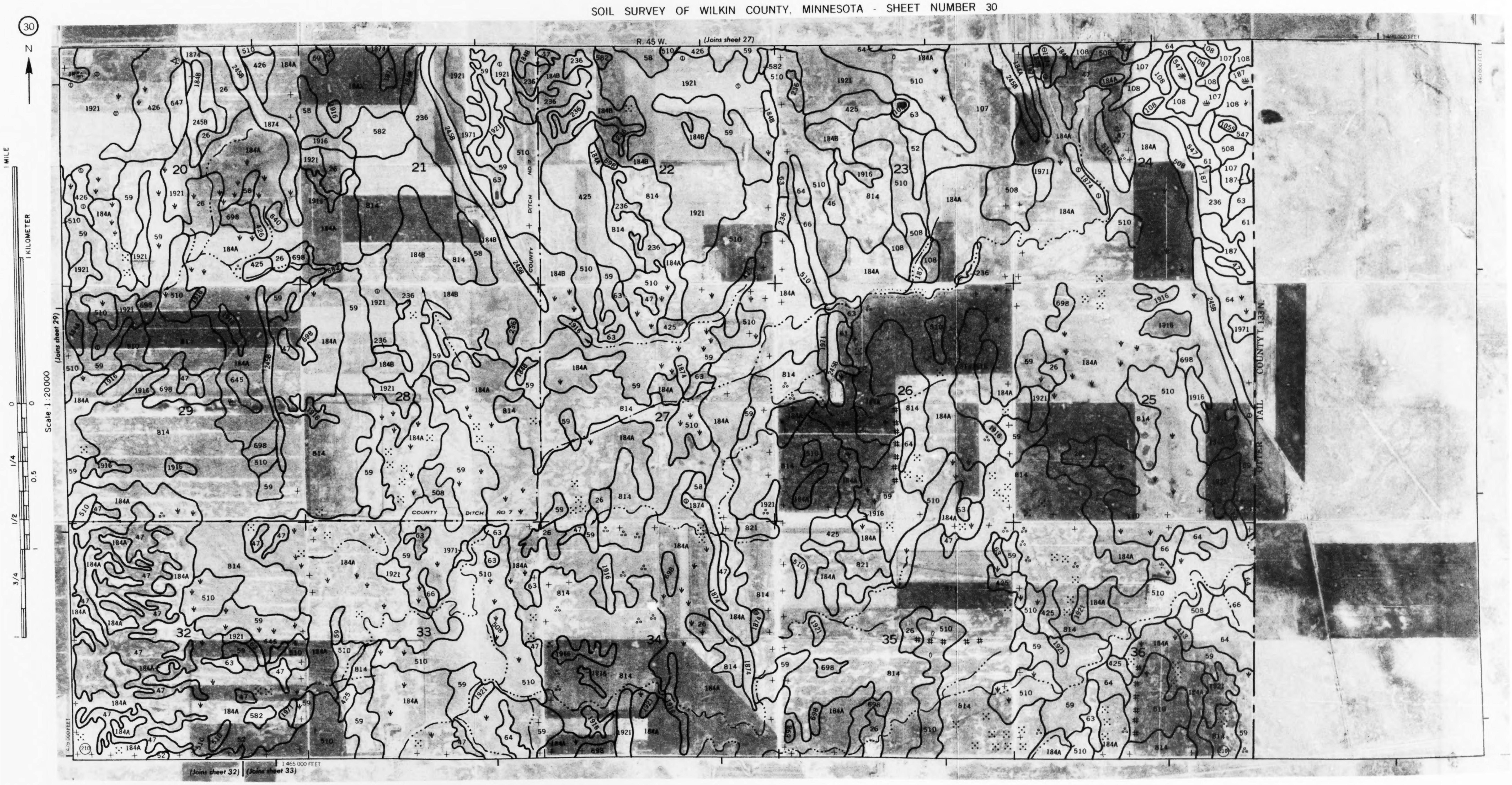
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 28


N
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
(Joins sheet 25)
(Joins sheet 31)
(Joins sheet 29)
R. 47 W. R. 46 W.
T. 133 N.
RICHLAND COUNTY
NORTH DAKOTA
RED RIVER OF THE NORTH
COUNTY DITCH NO 31
COUNTY DITCH NO 28
COUNTY DITCH NO 3
COUNTY DITCH NO 37
75
210
21
22
23
24
27
26
25
30
28
34
35
36
31
33
480 000 FEET
400 000 FEET
2 470 000 FEET
2 490 000 FEET

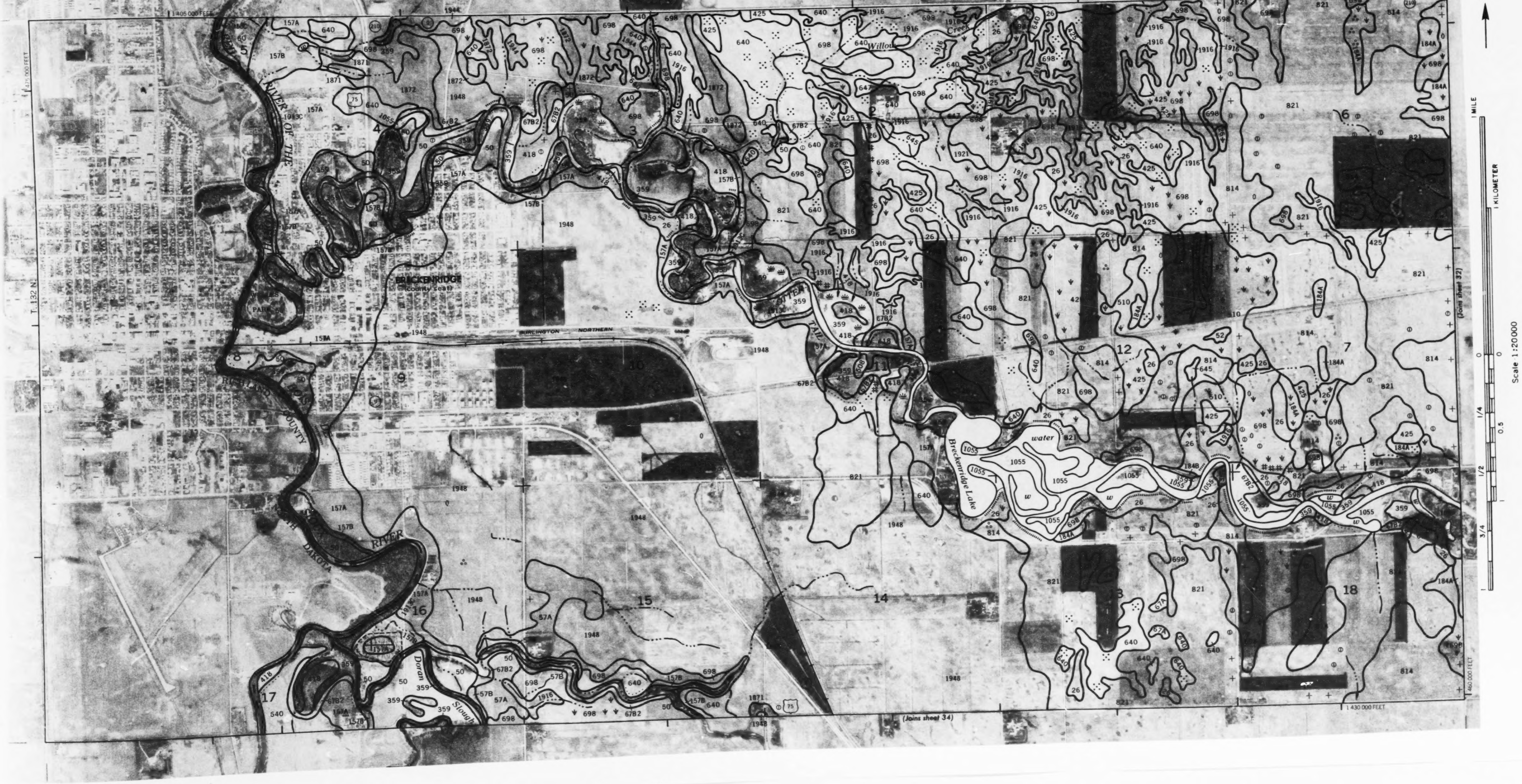
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 29


29
N
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 31)
(Joins sheet 32)
(Joins sheet 30)
R. 46 W.
R. 45 W.
T. 133 N.
1 430 000 FEET
490 000 FEET
475 000 FEET
1 460 000 FEET
COUNTY DITCH NO 31
COUNTY DITCH NO 3
COUNTY DITCH NO 7
COUNTY DITCH NO 37
19
21
22
23
24
25
26
27
28
30
31
33
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

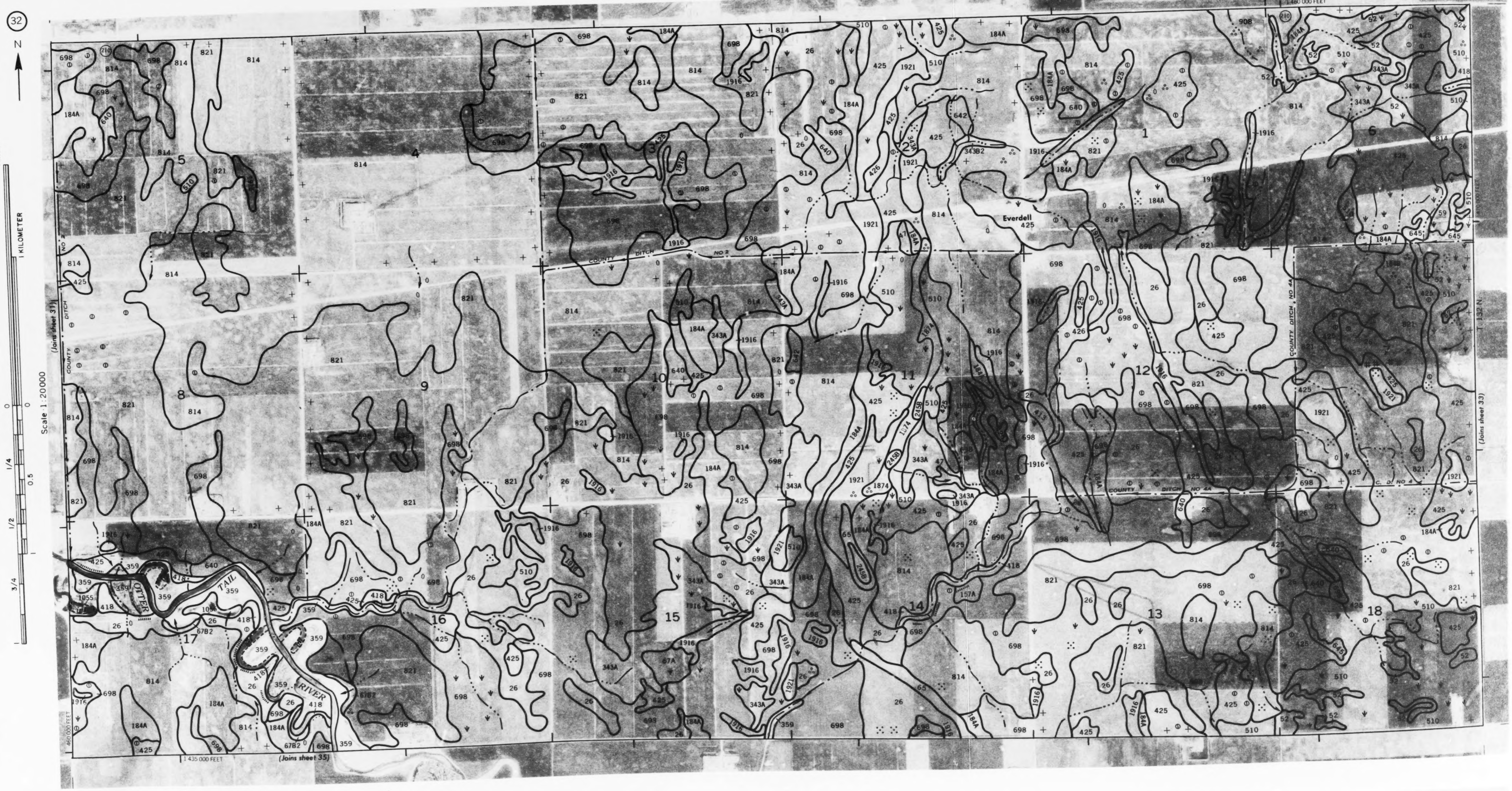
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 30


30
N
R. 45 W.
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 32)
(Joins sheet 33)
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
COUNTY DITCH NO 7
COUNTY DITCH NO
OTTER TAIL COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1 465 000 FEET
475 000 FEET

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 31

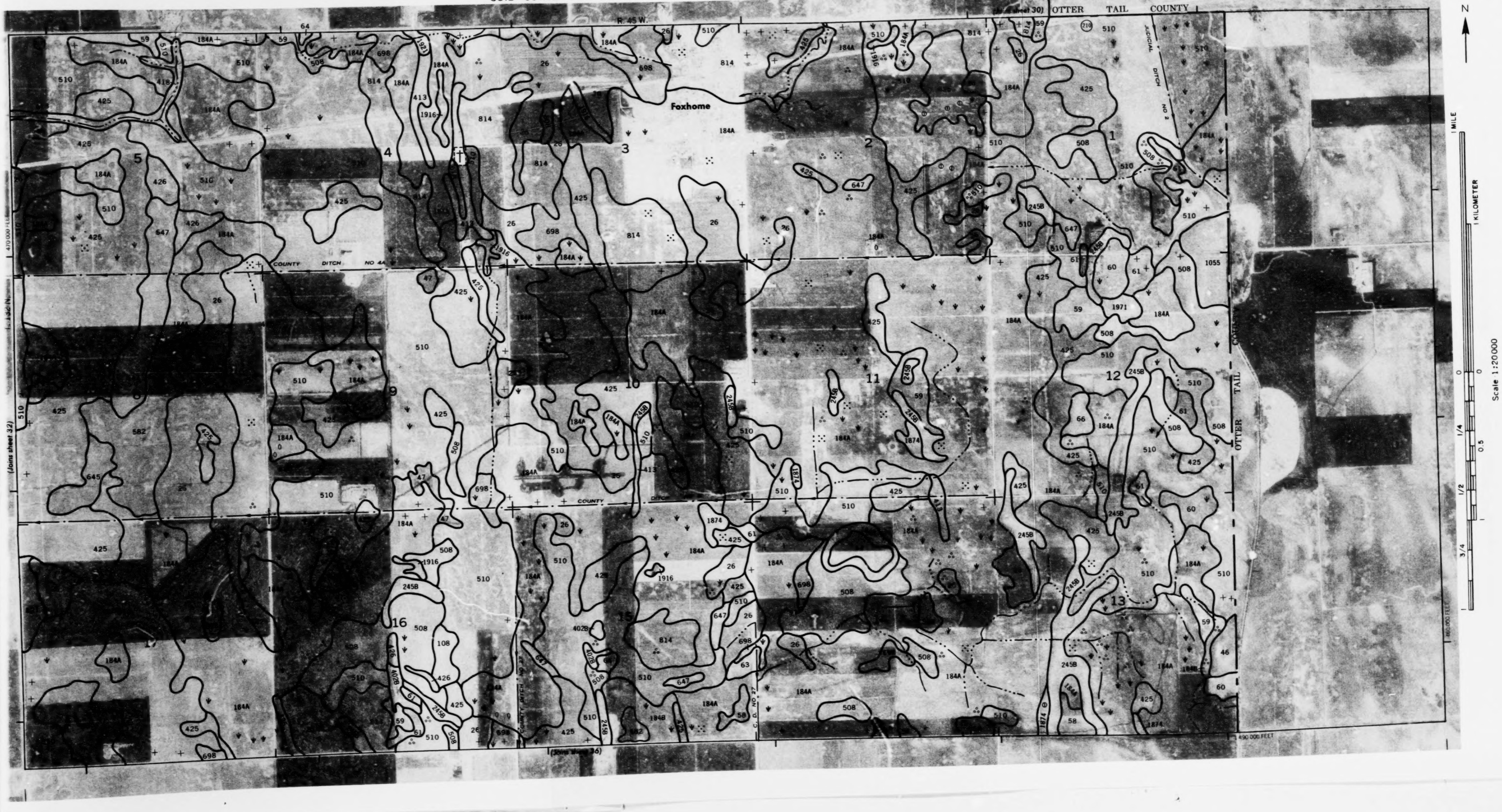

(Joins sheet 28)
(Joins sheet 29)
R. 47 W. | R. 46 W.
N
1 405 000 FEET
T. 132 N.
BRECKENRIDGE (County Seat)
BURLINGTON NORTHERN
Willow Creek
Breckenridge Lake
water
RICHLAND COUNTY
NORTH DAKOTA
RIVER
Doran Slough
(Joins sheet 32)
(Joins sheet 34)
1 430 000 FEET
460 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 32



32
N
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 29)
(Joins sheet 30)
R. 46 W.
R. 45 W.
1 460 000 FEET
(Joins sheet 31)
(Joins sheet 33)
T. 132 N.
(Joins sheet 35)
1 435 000 FEET
460 000 FEET
Everdell
OTTER TAIL RIVER
COUNTY DITCH NO 2
COUNTY DITCH NO 4A
COUNTY DITCH NO 4A
C. D. NO 4
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 33


(Joins sheet 30)
OTTER TAIL COUNTY
R. 45 W.
T. 132 N.
Foxhome
COUNTY DITCH NO 4A
COUNTY DITCH
JUDICIAL DITCH NO 2
OTTER TAIL
(Joins sheet 32)
(Joins sheet 36)
470 000 FEET
480 000 FEET
490 000 FEET
1
2
3
4
5
9
10
11
12
13
15
16
17
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

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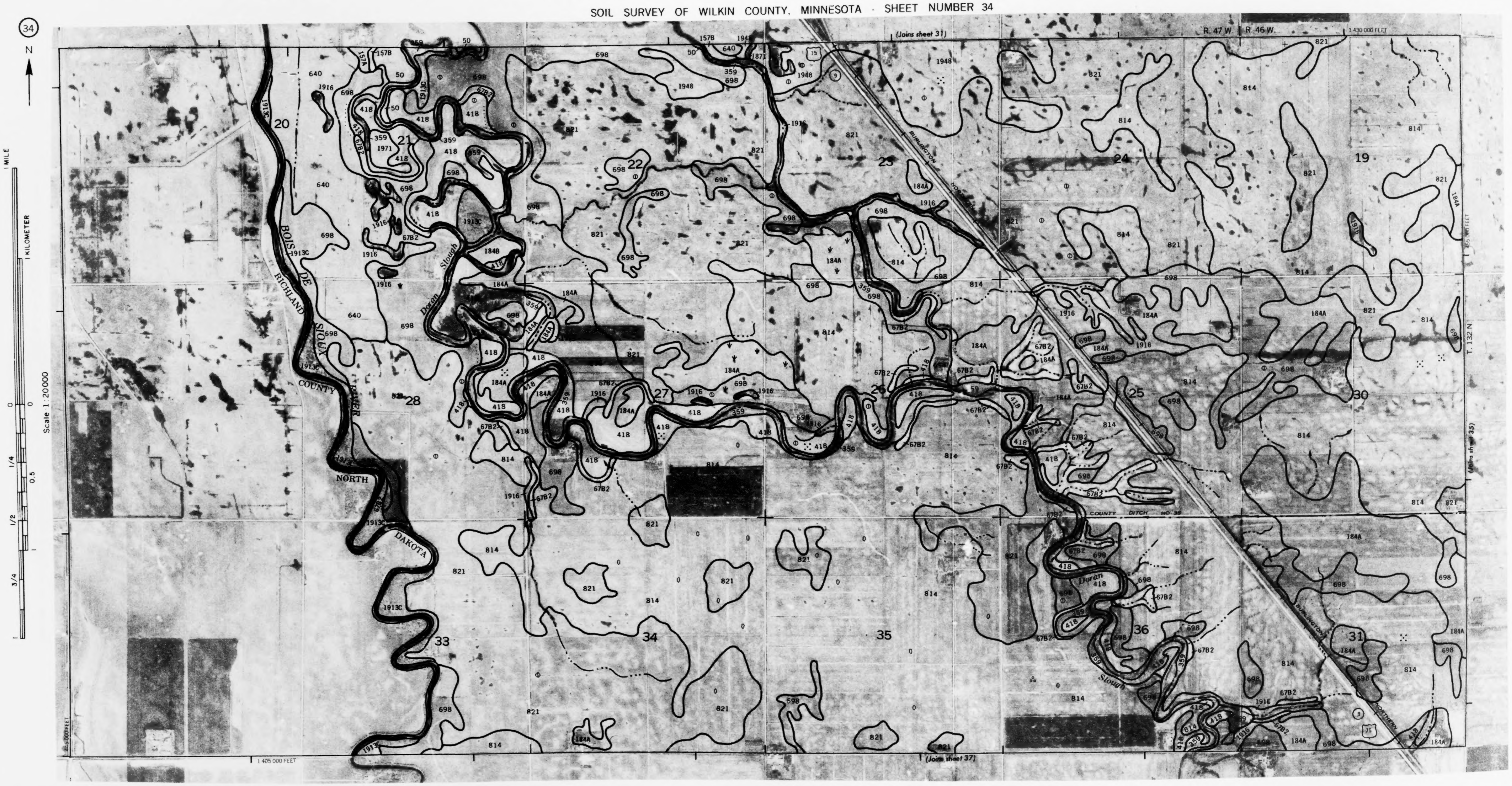
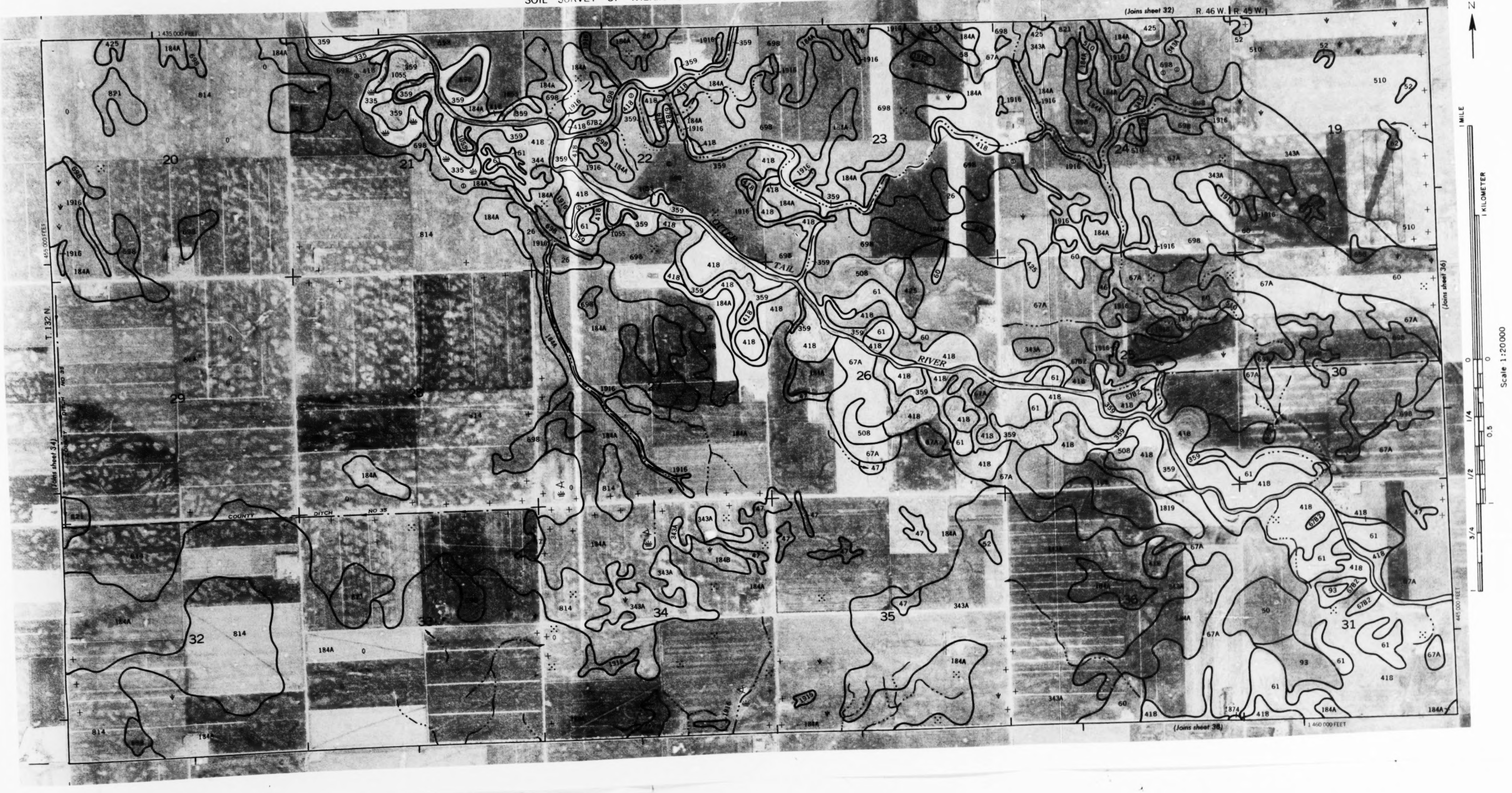
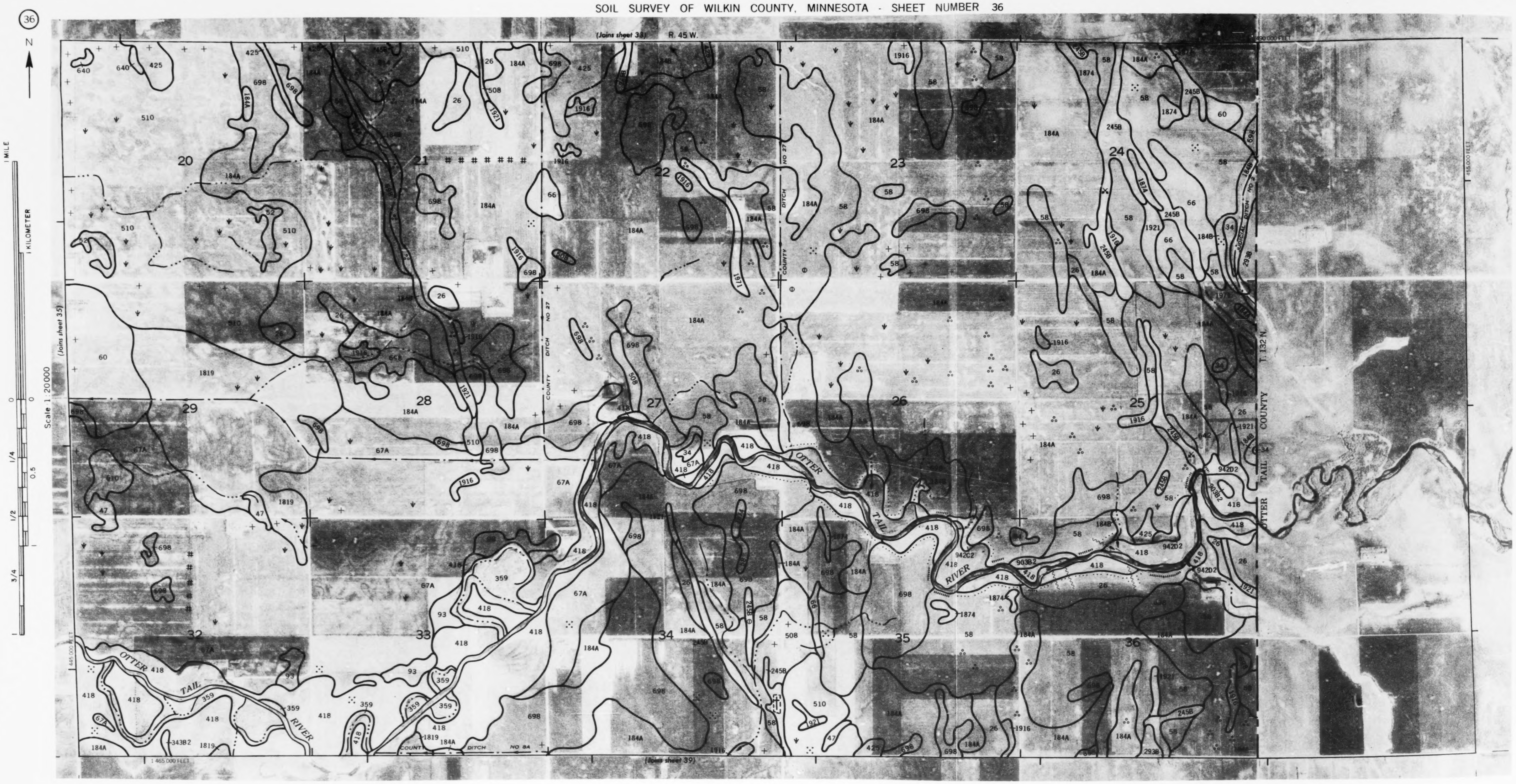
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 34


N
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
0
0.5
1
(Joins sheet 31)
(Joins sheet 35)
(Joins sheet 37)
R. 47 W.
R. 46 W.
T. 132 N.
1 430 000 FEET
1 405 000 FEET
BOIS DE SIOUX RIVER
RICHLAND COUNTY
NORTH DAKOTA
Doran Slough
COUNTY DITCH NO 3
BURLINGTON NORTHERN
75
9
19
20
21
22
23
24
25
26
27
28
30
31
33
34
35
36
50
157B
184A
359
418
640
67B2
698
814
821
1913C
1916
1948
1971

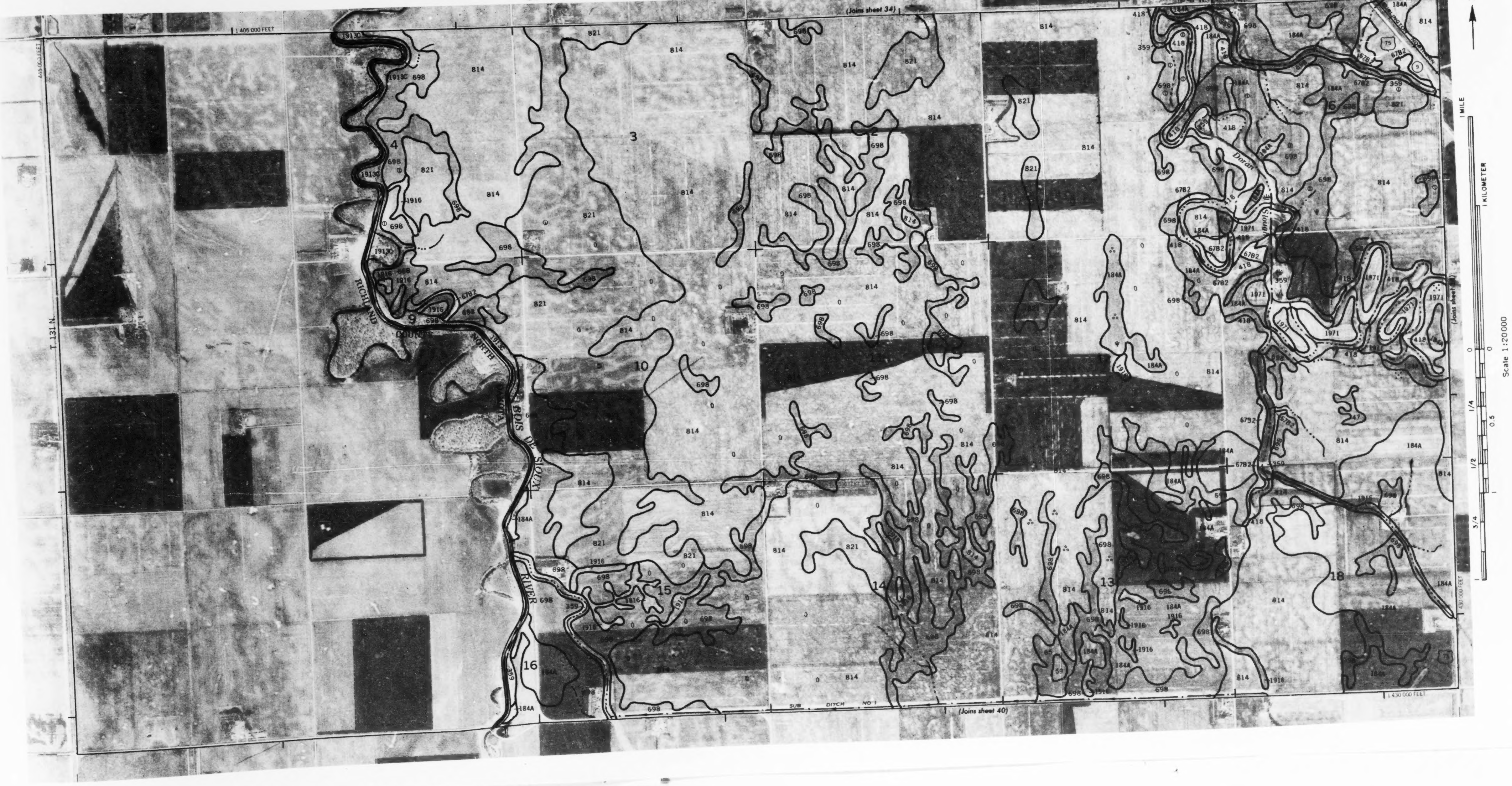
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA · SHEET NUMBER 35


(Joins sheet 32)
R. 46 W. | R. 45 W.
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
1
T. 132 N.
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 38)
1 435 000 FEET
1 460 000 FEET
450 000 FEET
445 000 FEET
OTTER TAIL RIVER
COUNTY DITCH NO 35
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
184A
184B
1916
359
418
698
814
61
60
67A
67B2
343A
425
510
52
26
47
50
93
508
1055
335
344
1819
8P1
0

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 36

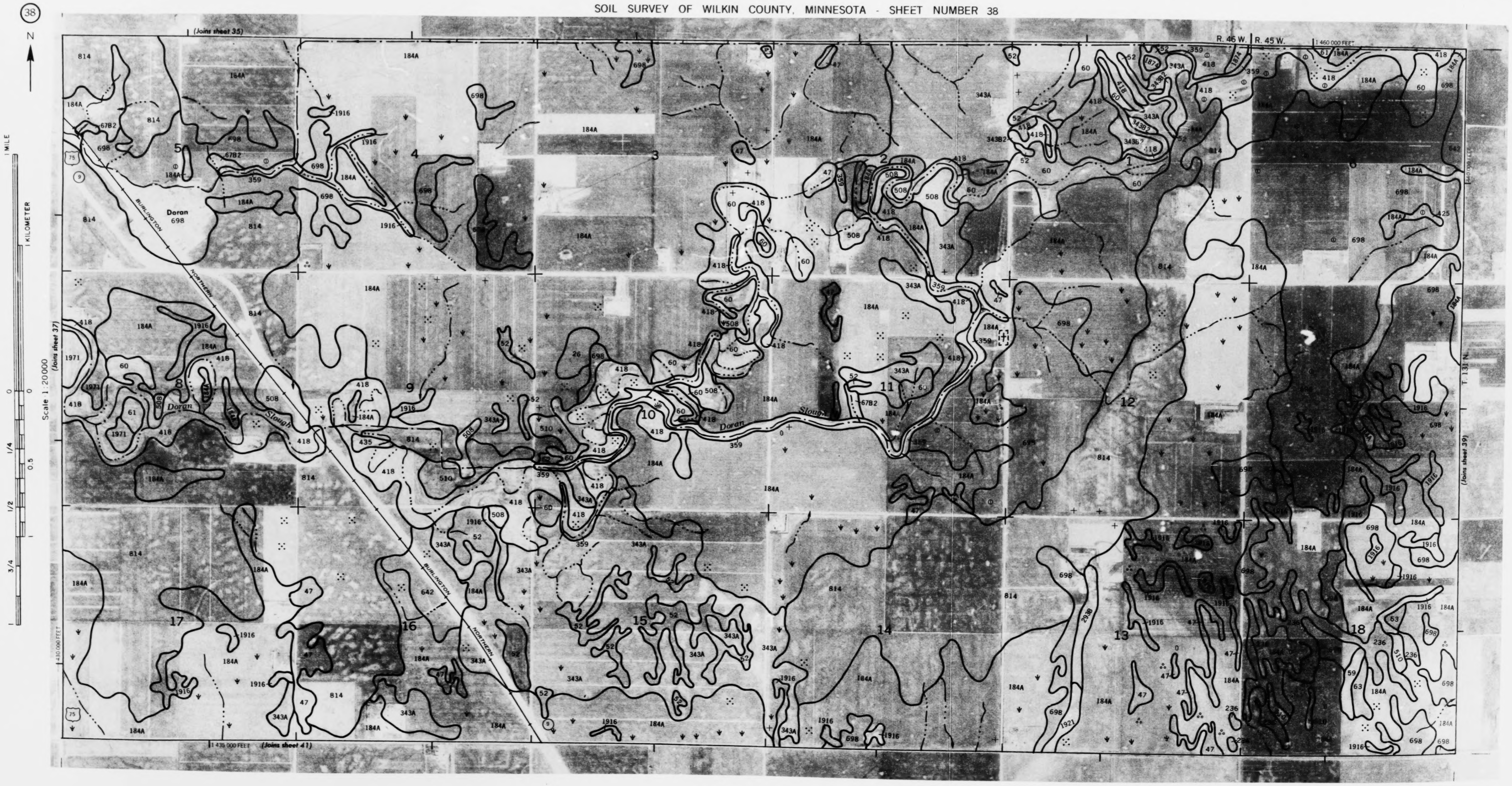

(Joins sheet 33)
R. 45 W.
(Joins sheet 35)
(Joins sheet 39)
T. 132 N.
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
COUNTY DITCH NO 27
COUNTY DITCH NO 8A
OTTER TAIL RIVER
OTTER TAIL COUNTY
1 465 000 FEET
445 000 FEET
455 000 FEET
490 000 FEET
184A
698
58
418
1916
1921
1874
245B
26
510
67A
359
93
1819
60
640
425
508
66
34
942D2
903B2
343B2
293B
47
52

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 37


(Joins sheet 34)
(Joins sheet 40)
1 405 000 FEET
1 430 000 FEET
445 000 FEET
430 000 FEET
T. 131 N.
R. 47 W.
RICHLAND COUNTY
NORTH DAKOTA
MINNESOTA
BOIS DE SIOUX RIVER
Doran Creek
SUB DITCH NO 1
75
9
1
2
3
4
6
9
10
13
14
15
16
18
814
821
698
1913C
1916
1971
184A
418
359
67B2
347
59
0
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
1
Scale 1:20000

(38)

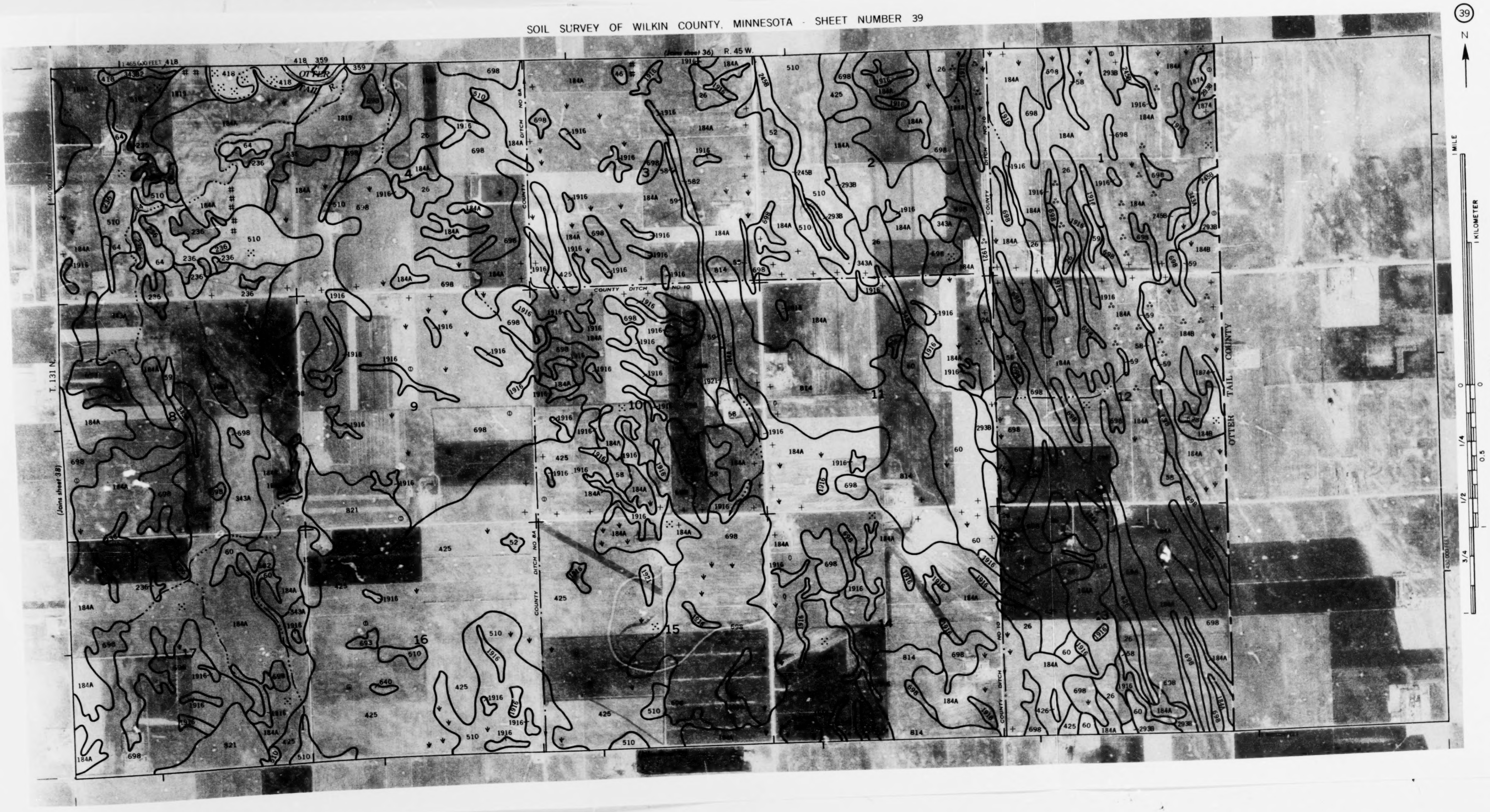
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 38


N
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 41)
R. 46 W.
R. 45 W.
T. 131 N.
1 460 000 FEET
1 435 000 FEET
430 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
Doran
Doran Slough
BURLINGTON NORTHERN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
75
9
814
184A
698
1916
359
418
60
508
343A
52
47
6782
1971
61
435
510
642
236
63
59
2938
1921
425
26

WILKIN COUNTY, MINNESOTA NO. 38

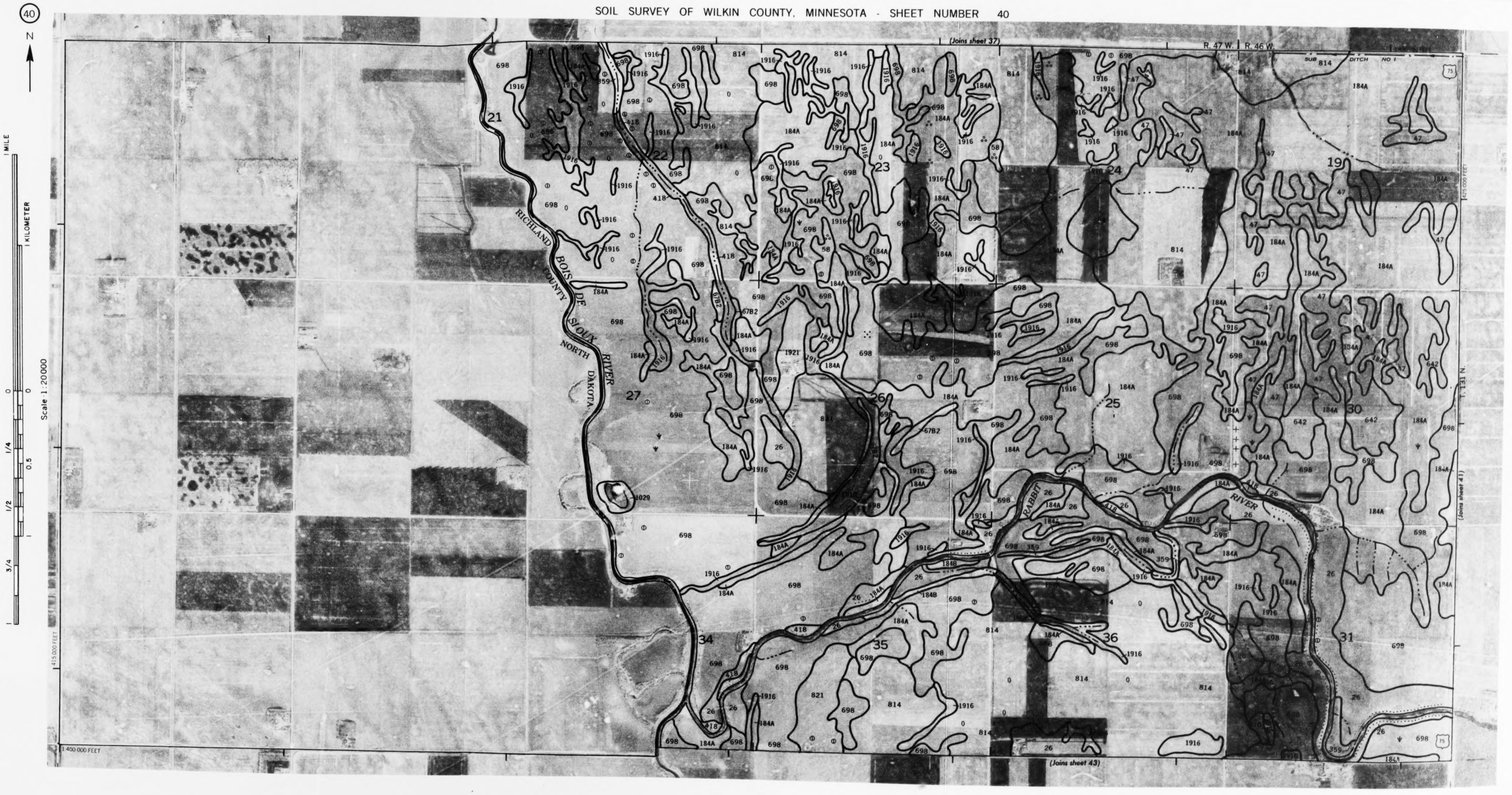
WILKIN COUNTY, MINNESOTA NO. 39

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 39


39
N
(Joins sheet 36)
R. 45 W.
T. 131 N.
(Joins sheet 38)
OTTER TAIL R.
COUNTY DITCH NO 10
COUNTY DITCH NO 8A
OTTER TAIL COUNTY
1
2
3
4
8
9
10
11
12
15
16
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000
184A
698
1916
510
425
60
26
293B
245B
343A
814
236
64
59
58

(40)

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 40


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
(Joins sheet 37)
R. 47 W.
R. 46 W.
SUB DITCH NO 1
75
425 000 FEET
T. 131 N.
(Joins sheet 41)
(Joins sheet 43)
415 000 FEET
1 400 000 FEET
RICHLAND COUNTY
NORTH DAKOTA
BOIS DE SIOUX RIVER
RABBIT RIVER
19
21
22
23
24
25
26
27
30
31
34
35
36
698
1916
814
184A
418
47
58
67B2
642
26
359
821
1921
1029
184B

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 41

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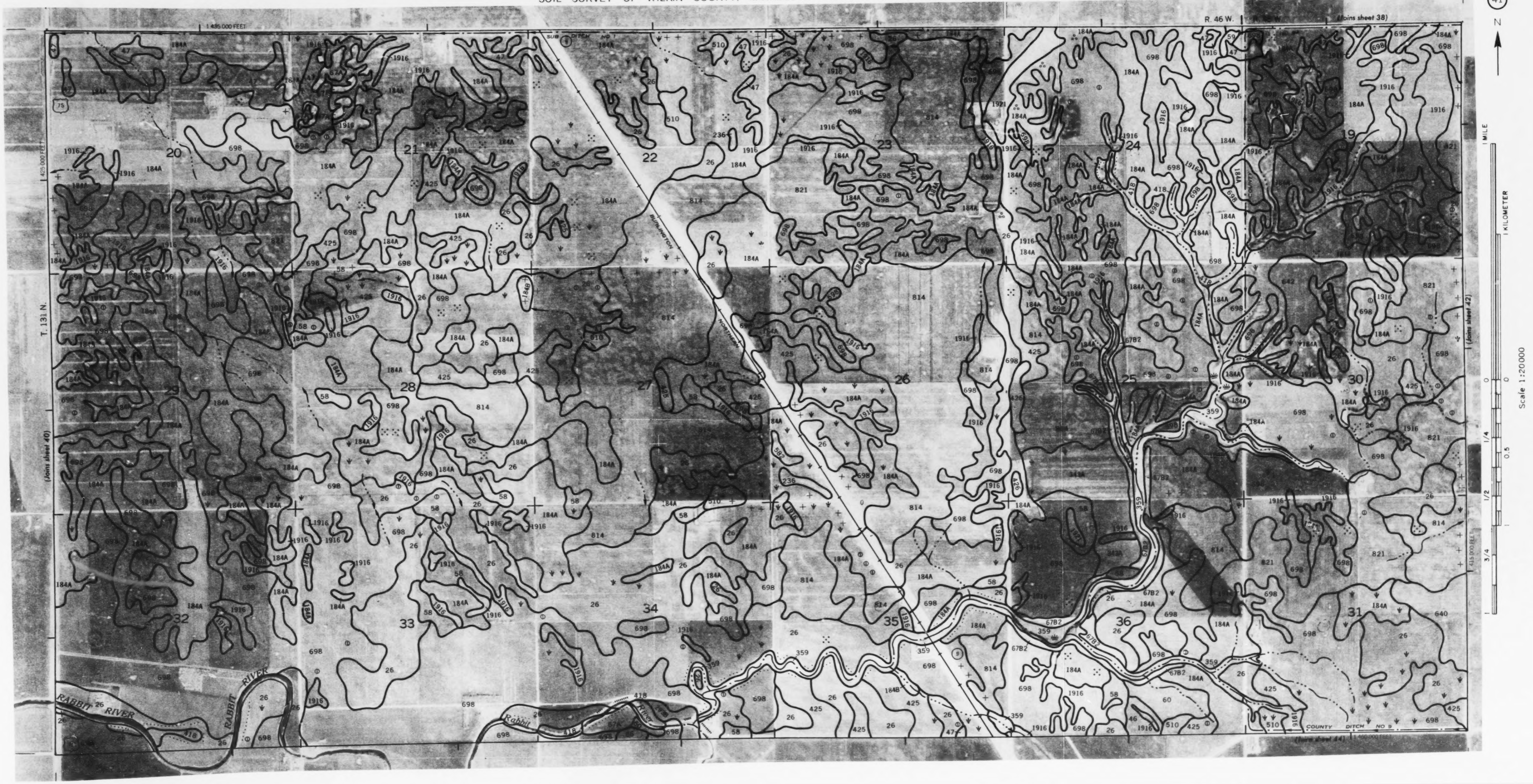
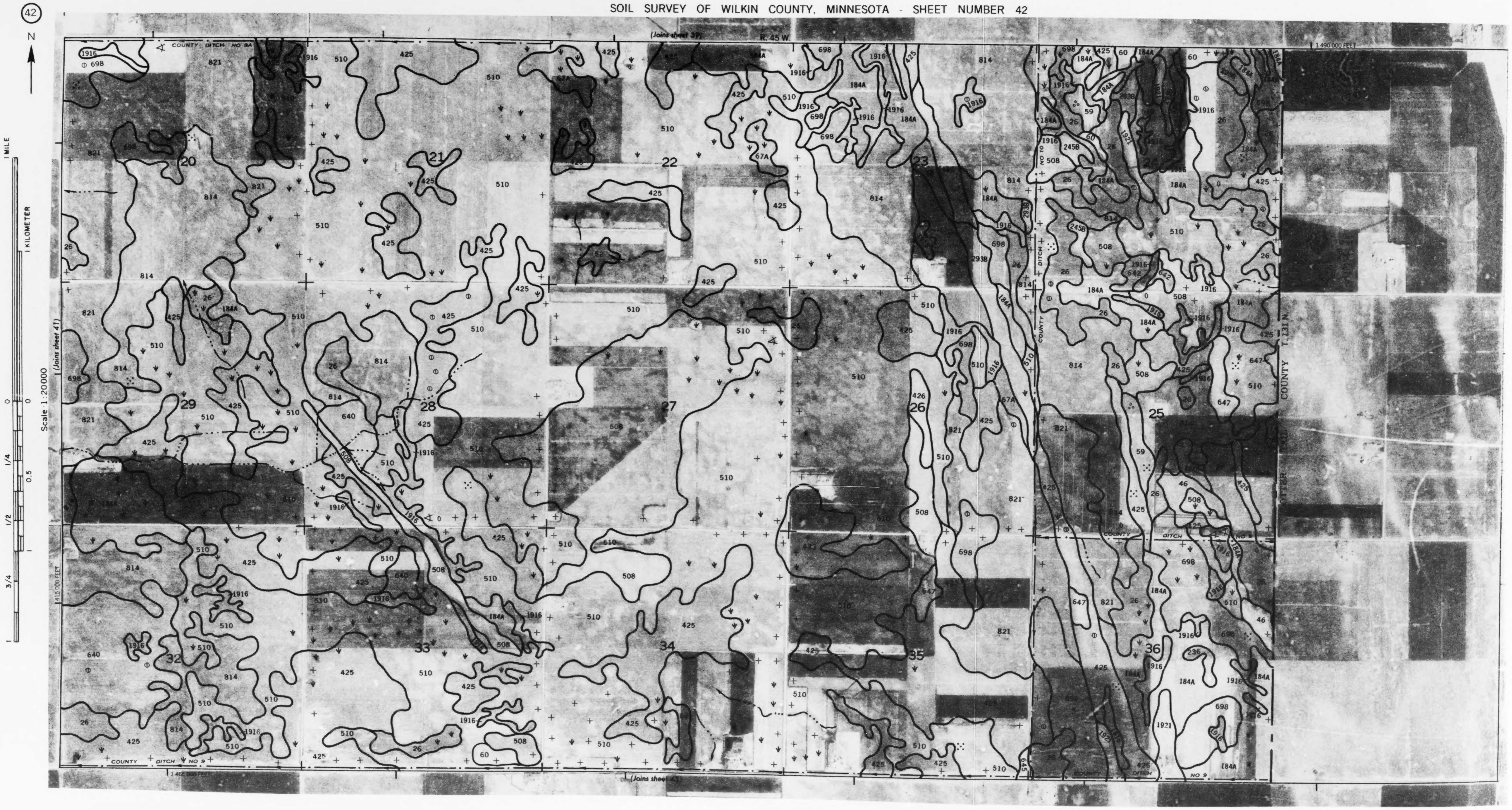
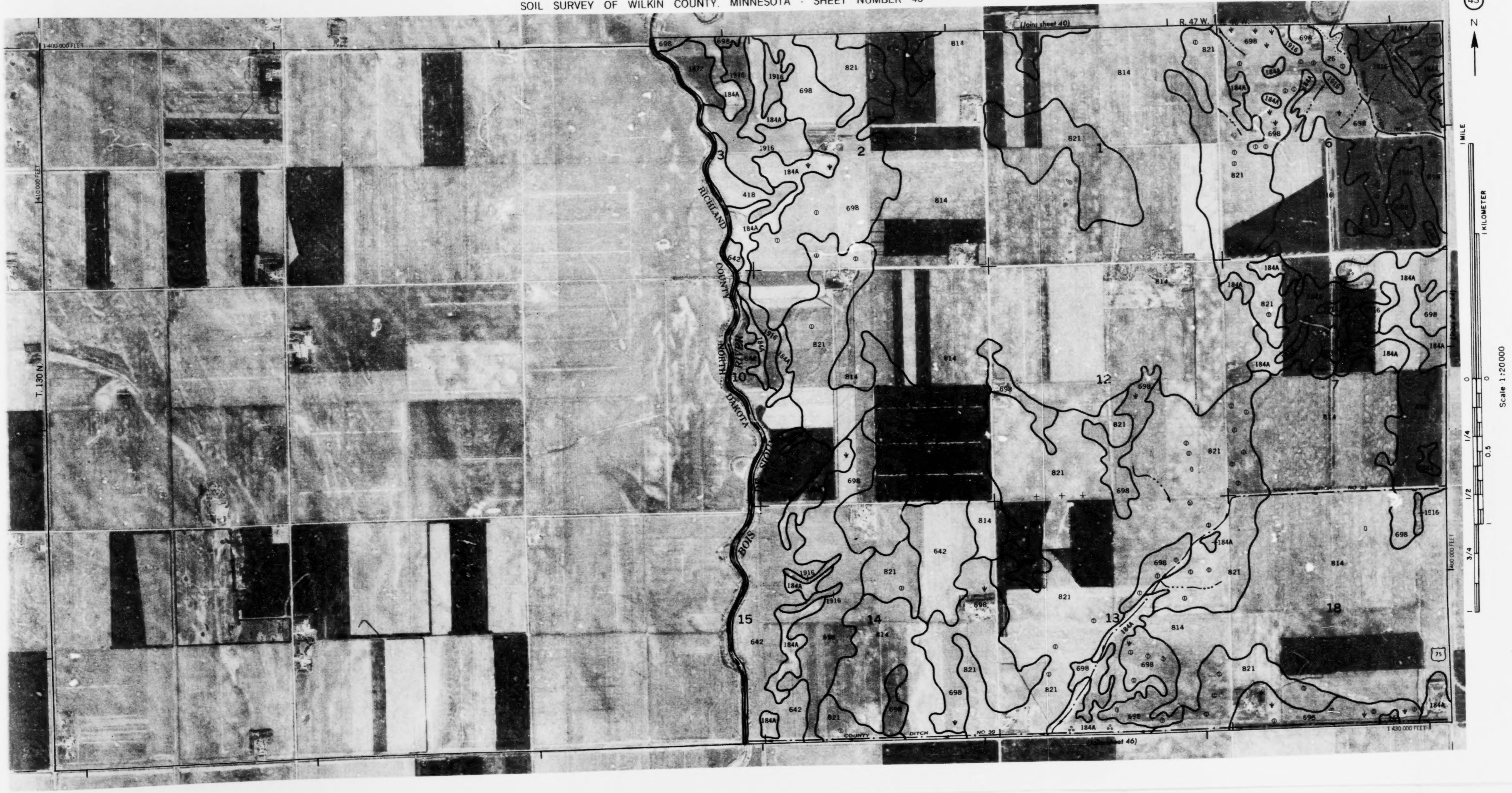

R. 46 W.
(Joins sheet 38)
(Joins sheet 42)
(Joins sheet 40)
(Joins sheet 44)
T. 131 N.
1 495 000 FEET
425 000 FEET
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
RABBIT RIVER
Rabbit River
COUNTY DITCH NO 9
BURLINGTON NORTHERN

(42)

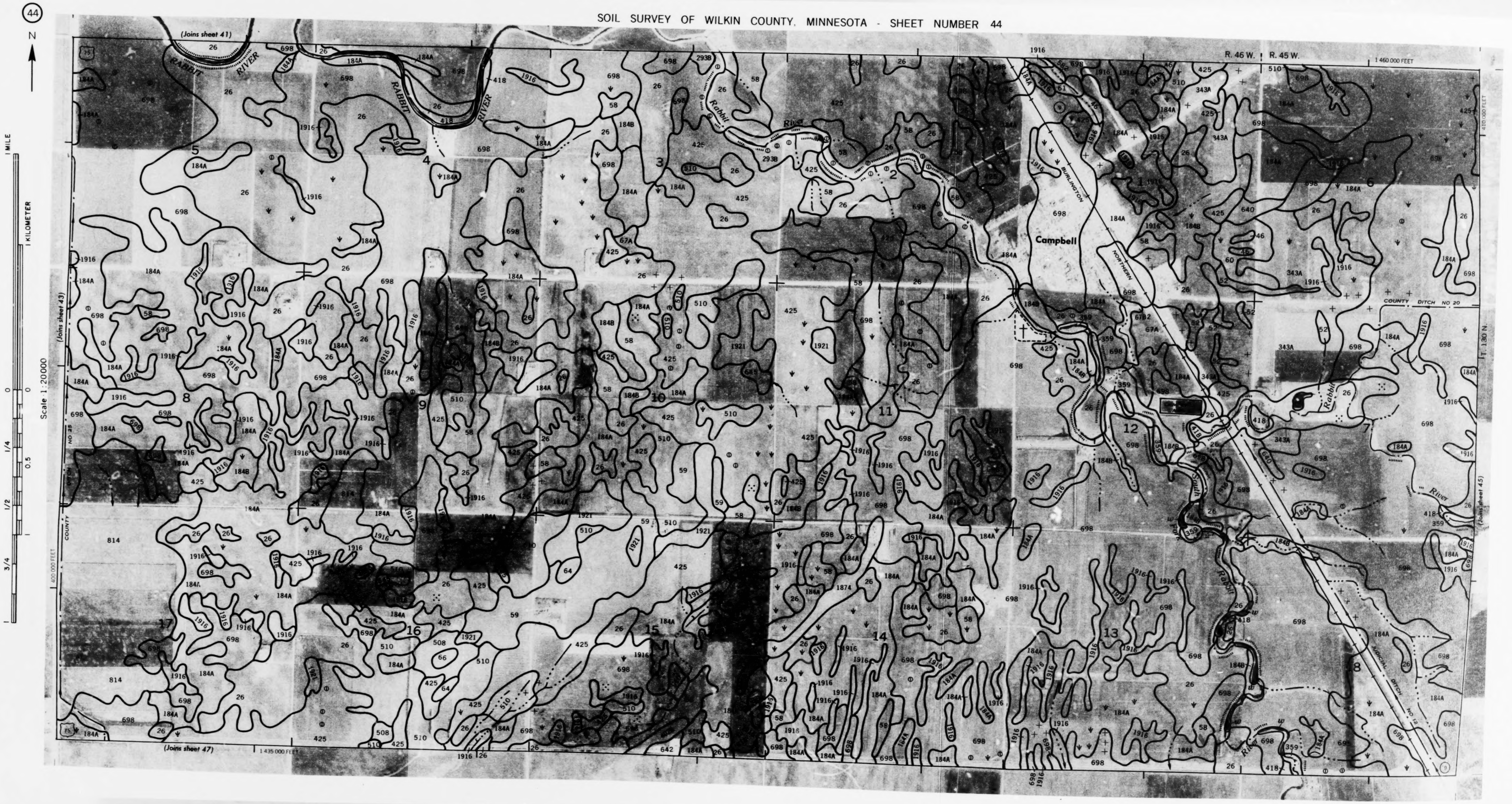
SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 42


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
(Joins sheet 37)
R. 45 W.
(Joins sheet 41)
(Joins sheet 43)
T. 131 N.
1 490 000 FEET
415 000 FEET
COUNTY DITCH NO 8A
COUNTY DITCH NO 9
COUNTY DITCH NO 10
OTTER TAIL COUNTY
20
21
22
23
25
26
27
28
29
32
33
34
35
36
26
46
59
60
67A
184A
236
245B
293B
425
426
508
510
640
642
645
647
698
814
821
1916
1921

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 43

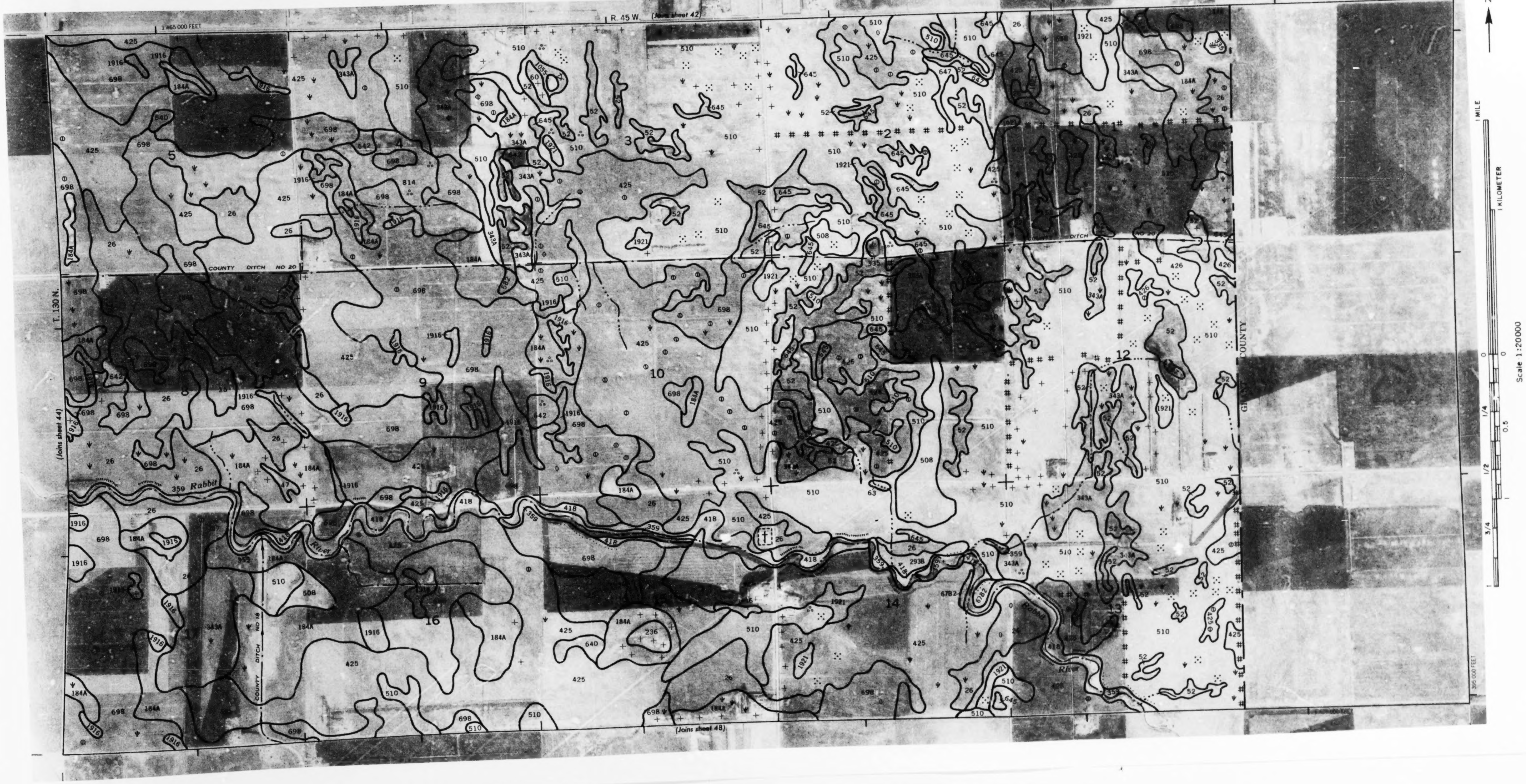

(Joins sheet 40)
R. 47 W.
1 400 000 FEET
410 000 FEET
T. 130 N.
RICHLAND COUNTY
NORTH DAKOTA
BOIS DE SIOUX RIVER
COUNTY DITCH NO 39
(Joins sheet 46)
(Joins sheet 44)
1 430 000 FEET
400 000 FEET
75
1
2
3
6
7
10
12
13
14
15
18
698
814
821
184A
1916
1872
642
418
26
N
1 MILE
0
1/4
1/2
3/4
1
KILOMETER
0
0.5
1
Scale 1:20000

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 44

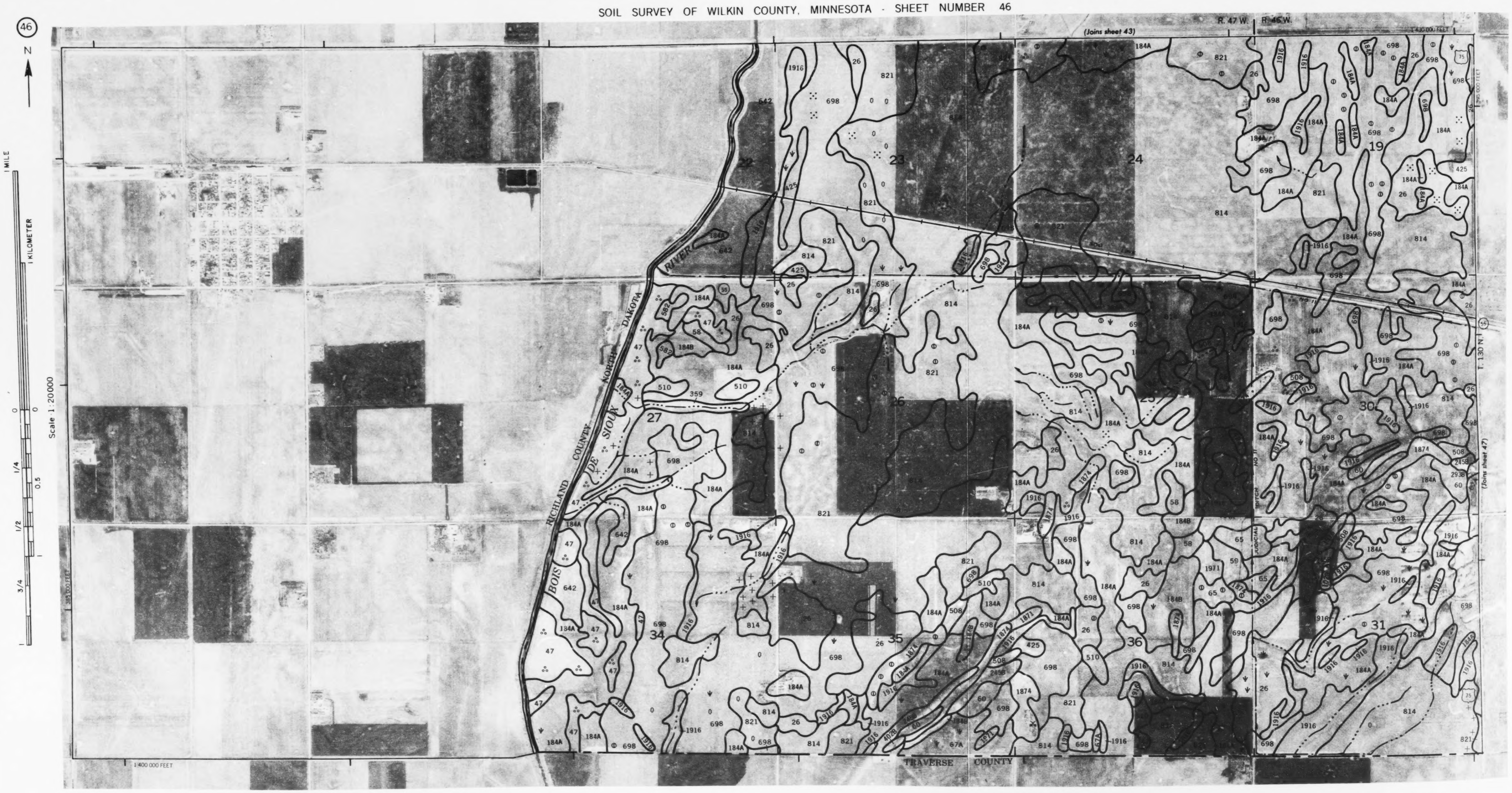

44
N
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 47)
RABBIT RIVER
Rabbit River
Campbell
BURLINGTON NORTHERN
COUNTY DITCH NO 20
COUNTY NO 25
JUDICIAL DITCH NO 12
R. 46 W.
R. 45 W.
T. 130 N.
1 460 000 FEET
1 435 000 FEET
400 000 FEET
410 000 FEET
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
26
58
184A
184B
698
1916
425
510
1921
343A
418
814

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 45

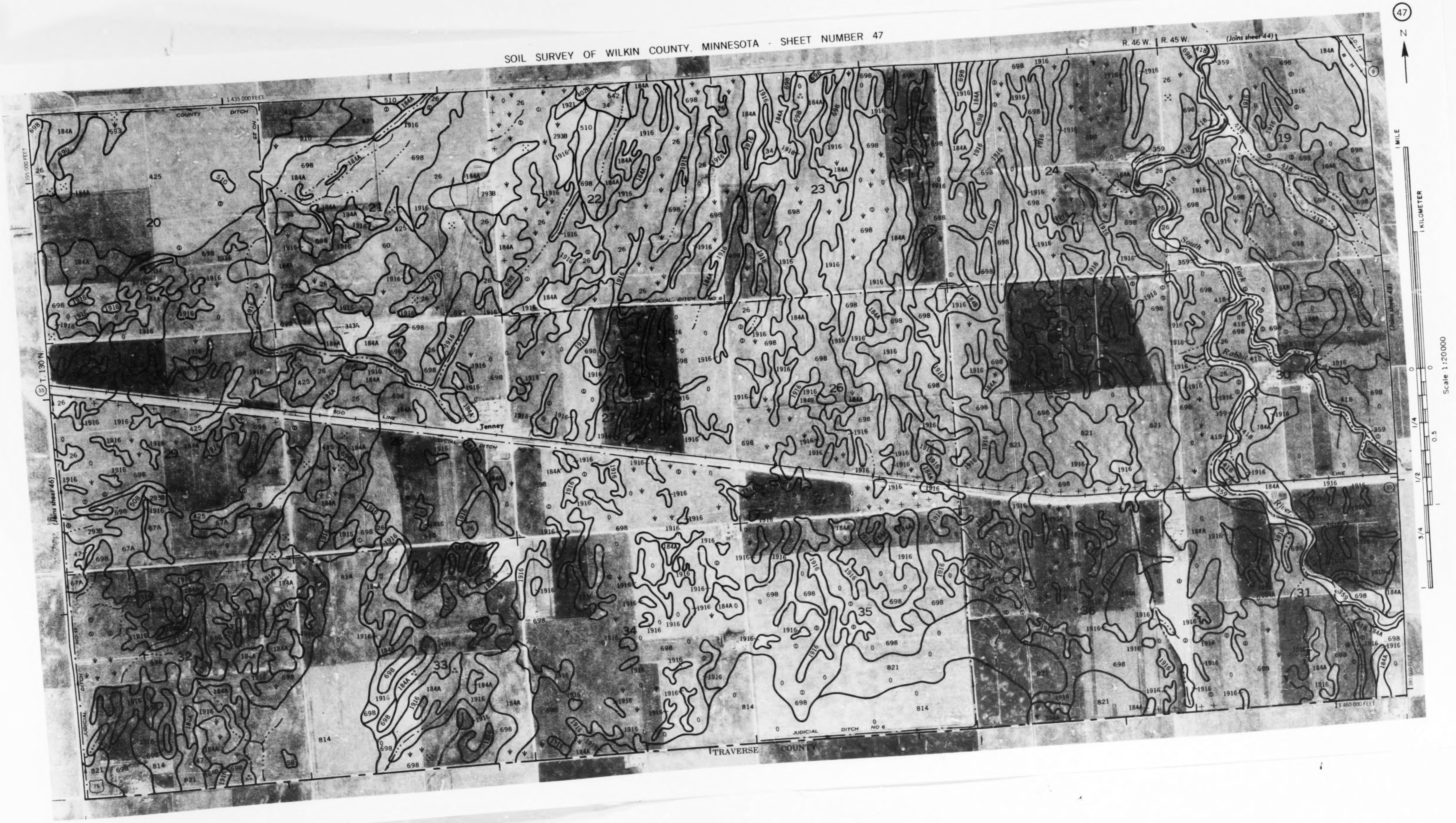
(45)


N
R. 45 W.
(Joins sheet 42)
1 465 000 FEET
T. 130 N.
(Joins sheet 44)
(Joins sheet 48)
395 000 FEET
COUNTY DITCH NO 20
COUNTY DITCH NO 18
COUNTY DITCH
Rabbit River
GRANT COUNTY
2
3
4
5
9
10
12
14
16
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 46

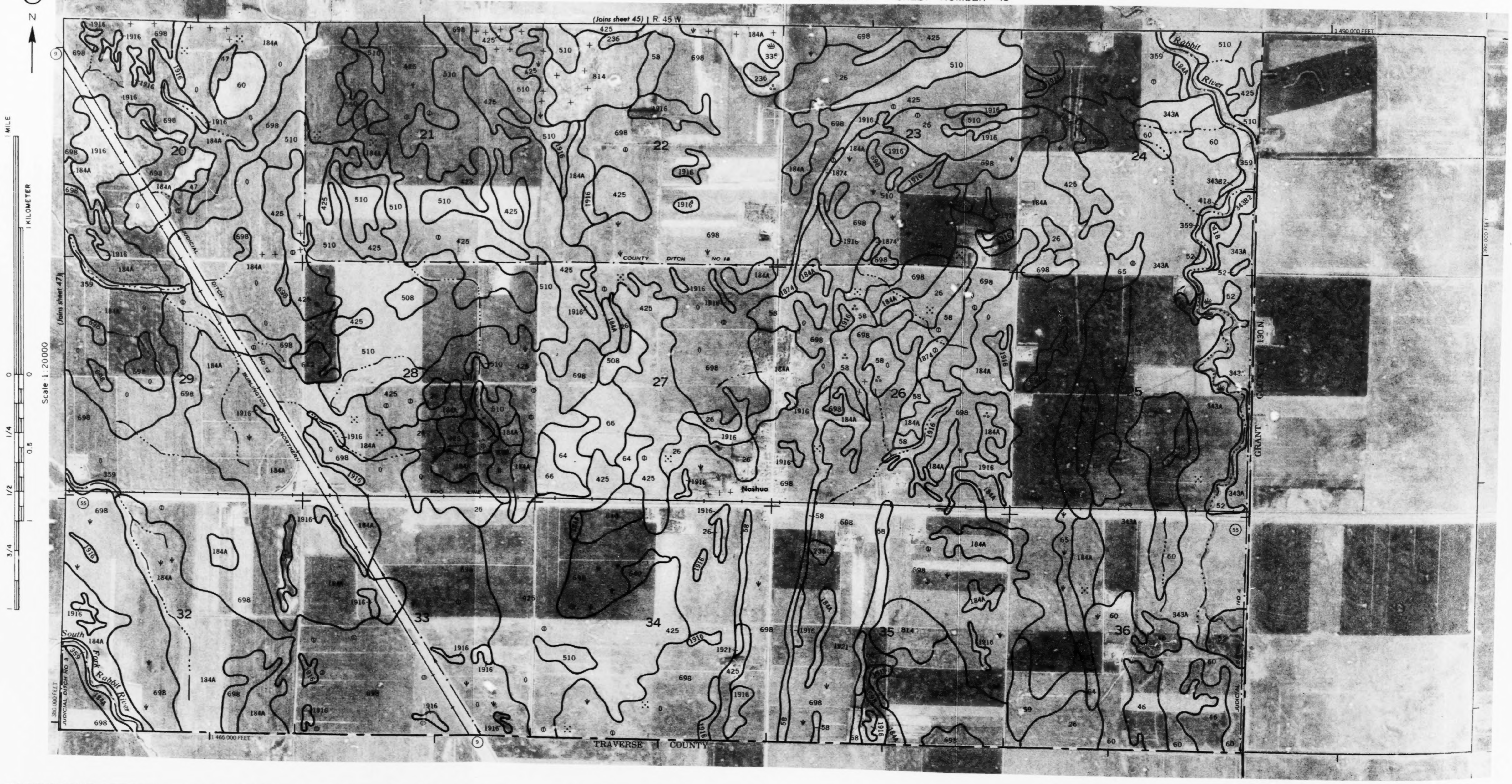

46
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
(Joins sheet 43)
R. 47 W.
R. 46 W.
T. 130 N.
(Joins sheet 47)
RICHLAND COUNTY
NORTH DAKOTA
BOIS DE SIOUX RIVER
TRAVERSE COUNTY
1 400 000 FEET
1 430 000 FEET
19
22
23
24
25
26
27
30
31
34
35
36
75
55

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 47


R. 46 W.
R. 45 W.
(Joins sheet 44)
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
1 435 000 FEET
1 460 000 FEET
195 000 FEET
T. 130 N.
(Joins sheet 46)
(Joins sheet 48)
COUNTY DITCH NO 25
JUDICIAL DITCH NO 6
SOO LINE
Jenney
South Fork
Rabbit River
TRAVERSE COUNTY
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

(48)

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 48


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000
(Joins sheet 45)
R. 45 W.
(Joins sheet 47)
1 490 000 FEET
1 465 000 FEET
380 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
COUNTY DITCH NO 38
JUDICIAL DITCH NO 12
Nashua
Rabbit River
South Fork Rabbit River
JUDICIAL DITCH NO 4
GRANT
130 N
TRAVERSE COUNTY
9
55
1916
698
184A
510
425
26
58
60
343A
1874
814
359
508
64
66
52
46